PROJECT MANUAL

FOR

SPROUTS™
FARMERS MARKET

Store #0680
3111 Mahan Drive, #18,
Tallahassee, FL 32308

LDG# 13624-031

Prepared by:

495 N Keller Road, Suite 101
Maitland, FL 32751
Phone: 689-710-0035
Email:
LDG-SFM-CA@larsondesigngroup.com

04/24/2026

V6.2.9.1_20251015 PROTOTYPE

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SECTION 000103
PROJECT DIRECTORY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification of project team members and their contact information.

1.02 OWNER:

A. Name: Sprouts Farmers Market
   1. Address Line 1: 5455 East High Street, Suite 111
   2. Address Line 2: Phoenix, AZ 85054
   3. Telephone: 480-814-8016
   4. Fax:480-814-8017
   5. Email: Keevin.Simpson@Sprouts.com

B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Title: Technical Manager
   2. Name: Jim Churski
   3. Email: LDG-SFM-CA@larsondesigngroup.com

1.03 CONSULTANTS:

A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
   1. Company Name: BRR Architecture.
      a. Address Line 1: 8131 Metcalf Avenue, Suite 300
      b. Address Line 2: Overland Park, KS 66204
      c. Telephone: 913-262-9095
      d. Fax:(913) 262-9094
   2. Primary Contact: Kelsey Sundet
      a. Title: Project Manager.

B. Structural Engineering Consultant: A.V. Schwan and Assoc.
   1. Company Name: A.V. Schwan and Assoc.
      a. Address Line 1: 6000 E. Thomas Road, Suite 1
      b. City: Scottsdale
      c. State: Arizona
      d. Zip Code: 85251
      e. Telephone: 602-265-4331

f. Fax: 480-663-1788

2. Primary Contact:
   a. Title: Structural Engineer.
   b. Name: Mo Kateeb
   c. Email: mkateeb@avschwan.com

C. Plumbing Engineering Consultant:
1. Company Name: Henderson Engineers
   a. Address Line 1: 5343 North 16th Street
   b. Address Line 2: Suite 460
   c. City: Phoenix
   d. State: Arizona
   e. Zip Code: 85016
   f. Telephone: 602-336-5200
   g. Fax: 480-663-1788
2. Primary Contact:
   a. Title: Project Manager.
   b. Name: Chris Kelsey
   c. Email: Chris.Kelsey@hendersonengineers.com

D. Electrical / Mechanical Engineering Consultant:
1. Company Name: Henderson Engineers
   a. Address Line 1: 5343 North 16th Street
   b. Address Line 2: Suite 460
   c. City: Phoenix
   d. State: Arizona
   e. Zip Code: 85016
   f. Telephone: 602-336-5200
   g. Fax: 480-663-1788
2. Primary Contact:
   a. Title: Project Manager.
   b. Name: Chris Kelsey
   c. Email: Chris.Kelsey@hendersonengineers.com

E. Refrigeration Engineer:
1. Company Name: Arctic Cooling Systems.
   a. Address Line 1: 14350 Cherokee Pl..
   b. City: Chino.
   c. State: California.
   d. Zip Code: 91710.
   e. Telephone: 909-270-2111.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 000103

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SECTION 000107.01
SEALS PAGE - ARCHITECTURAL

DESIGN PROFESSIONAL OF RECORD

Chris Coonce
Larson Design Group, Inc.
495 N Keller Road, Suite 101,
Maitland, FL 32751
Phone: 689-710-0035

SPROUTS FARMERS MARKET - Store #0680 Tallahassee, FL

I hereby specify that the specification sections intended to be authenticated by my seal are those in Divisions 02, 04, 05, 06, 07, 08, 09, 10, 11, 12, 31 and 32 except where indicated as prepared by other design professionals of record.

Digitally signed by Chris Coonce
DN: E=ccoonce@larsondesigngroup.com, CN=Chris Coonce, O=LARSON DESIGN GROUP INC., OID.2.5.4.97="NTRUS+PA-981246", L=WILLIAMSPORT, S=PENNSYLVANIA, SERIALNUMBER=MAS20260206784864, C=US
Reason: This document has been electronically signed and sealed by Christopher Coonce. Printed copies of this document are not considered signed and sealed and all digital versions of this document must be verifiable.
Date: 2026.04.24 11:23:43-04'00'

CHRISTOPHER M COONCE
FL AR99920 04/24/2026

ARCHITECT OF RECORD DATE

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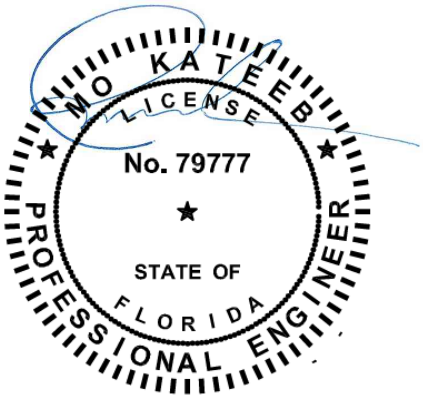
SECTION 000107.02
SEALS PAGE - STRUCTURAL

DESIGN PROFESSIONAL OF RECORD

A.V. Schwan and Assoc.
Mo Kateeb
6000 E. Thomas Road, Suite 1
Scottsdale, Arizona 85251
Phone: 602-265-4331
Fax: 480-663-1788
Email: mkateeb@avschwan.com

SPROUTS FARMERS MARKET – Store #0680 Tallahassee, FL

I hereby specify that the specification sections intended to be authenticated by my seal are limited to:
033000 - Cast-In-Place Concrete
033100 - Interior Concrete Slabs on Ground
042000 - Unit Masonry
051200 - Structural Steel Framing
054000 - Cold-Formed Metal Framing



STRUCTURAL ENGINEER OF RECORD

04-14-26
DATE

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SECTION 000107.03
SEALS PAGE - MECHANICAL / PLUMBING

DESIGN PROFESSIONAL OF RECORD

Henderson Engineers
Jarrod M. Easterwood
Engineer of Record
8345 Lenexa Drive
Lenexa, KS 66214
Phone: (913) 742-5728

Email: Jarrod.Easterwood@hendersonengineers.com

SPROUTS FARMERS MARKET – Store #0680 Tallahassee, FL

I hereby specify that the specification sections intended to be authenticated by my seal are those in Divisions 20 22, and 23 except where indicated as prepared by other design professionals of record.

THIS ITEM HAS BEEN
ELECTRONICALLY SIGNED
AND SEALED BY
JARROD M. EASTERWOOD
ON THE DATE LISTED BELOW
USING A DIGITAL SIGNATURE.

PRINTED COPIES OF THIS
DOCUMENT ARE NOT
CONSIDERED SIGNED AND
SEALED AND THE
SIGNATURE MUST BE
VERIFIED ON ANY
ELECTRONIC COPIES.

04/16/2026

4/16/2026

MECHANICAL / PLUMBING ENGINEER OF RECORD DATE

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SECTION 000107.04
SEALS PAGE - ELECTRICAL

DESIGN PROFESSIONAL OF RECORD

Henderson Engineers
Dean W. Chandler
Engineer of Record
8345 Lenexa Drive
Lenexa, KS 66214
Phone: (913) 742-5675

Email: Dean.Chandler@hendersonengineers.com

SPROUTS FARMERS MARKET – Store #0680 Tallahassee, FL

I hereby specify that the specification sections intended to be authenticated by my seal are those in Division 26 except where indicated as prepared by other design professionals of record.

THIS ITEM HAS BEEN
ELECTRONICALLY SIGNED
AND SEALED BY
DEAN CHANDLER
ON THE DATE LISTED BELOW
USING A DIGITAL SIGNATURE.

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DOCUMENT ARE NOT
CONSIDERED SIGNED AND
SEALED AND THE
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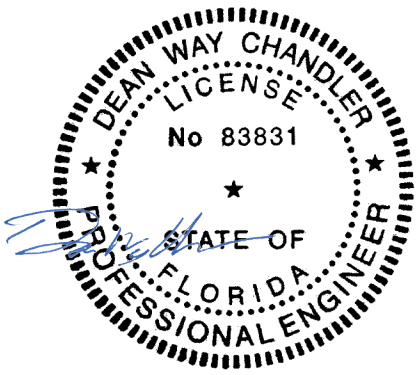

4/16/2026

ELECTRICAL ENGINEER OF RECORD DATE

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SECTION 000107.05
SEALS PAGE - FIRE PROTECTION

DESIGN PROFESSIONAL OF RECORD

Henderson Engineers
Christopher J. Culp
Engineer of Record
8345 Lenexa Drive
Lenexa, KS 66214
Tel: (913) 742-5412

Email: christopher.culp@hendersonengineers.com

THIS ITEM HAS BEEN ELECTRONICALLY SIGNED AND SEALED BY CHRISTOPHER J. CULP ON THE DATE LISTED BELOW USING A DIGITAL SIGNATURE.

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

4/16/2026

SPROUTS FARMERS MARKET – Store #0680 Tallahassee, FL

I hereby specify that the specification sections intended to be authenticated by my seal are those in Division 21, 28 except where indicated as prepared by other design professionals of record.

FIRE PROTECTION ENGINEER OF RECORD DATE

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END OF SECTION 000110

SECTION 000116
GLOBAL TERMS - CHECKLIST

GLOBAL TERMS LIST FOR: SPROUTS FARMERS MARKET

0.01 RIB / LDG GLOBAL TERMS

A. Architect of Record: Larson Design Group, Inc.
B. Architect of Record - Primary Signer: Chris Coonce
C. LDG Address Line 1: 495 N Keller Road, Suite 101
D. LDG Address Line 2: Maitland, FL 32751
E. LDG PM Email: rsmith@larsondesigngroup.com
F. LDG Project Manager: Robert Smith
G. LDG Phone: 689-710-0035
H. Contract Documents Due Date: 04/24/2026
I. Geotechnical Engineer: Geotechnical Engineer
J. Geotechnical' s Report Date: Geotechnical Report Date
K. MEP Address Line 1: 5343 North 16th Street
L. MEP Address Line 2: Suite 460
M. MEP City: Phoenix
N. MEP Company Name: Henderson Engineers
O. MEP Fax: 480-663-1788
P. MEP Phone: 602-336-5200
Q. MEP Primary Contact: Chris Kelsey
R. MEP Primary Contact Email: Chris.Kelsey@hendersonengineers.com
S. MEP State: Arizona
T. MEP Zip Code: 85016
U. Owner Address Line 1: 5455 East High Street, Suite 111
V. Owner Address Line 2: Phoenix, AZ 85054
W. Owner City: Phoenix
X. Owner Contact: Keevin Simpson
Y. Owner Contact Email: KeevinSimpson@sprouts.com
Z. Owner Contact Phone: 480-814-8016
AA. Owner Fax: 480-814-8017
BB. Owner State: AZ
CC. Owner Zip: 85054
DD. Owner's Actual Name: Sprouts Farmers Market
EE. Project ID / LDG Project Number: D0005127 / 13624-031
FF. Project Location Address 1: 3111 Mahan Drive
GG. Project Location Address 2: Unit #18
HH. Project Location City: Tallahassee

II. Project Location State: Florida
JJ. Project Location Zip: 32308
KK. Project Name: Tallahassee, FL EBTS
LL. Project Name Header: Sprouts Farmers Market
MM. Prototype Version: V6.2.9.1_20251015 PROTOTYPE
NN. Store Number: 0680
OO. Structural Address Line 1:6000 E. Thomas Road, Suite 1
PP. Structural City: Scottsdale
QQ. Structural Email: mkateeb@avschwan.com
RR. Structural Phone: 602-265-4331
SS. Structural Primary Contact: Mo Kateeb
TT. Structural State: Arizona
UU. Structural Zip: 85251

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 000116

SECTION 007200
GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

1.01 The General Conditions for this project shall be based on AIA Documents A201 (latest edition).

1.02 The following Supplementary General Conditions have been based on AIA Document A201, (latest edition).

1.03 Original copies of AIA Documents A201, (latest edition) are available at local AIA offices.

END OF SECTION 007200

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SECTION 007300 – SUPPLEMENTARY GENERAL CONDITIONS
(Verify this section if bids are by Landlord/Developer for BTS / EBTS projects.)

The following supplements, modifies, deletes and/or adds to the AIA General Conditions, A201, 2007. Where any article, paragraph or subparagraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph or subparagraph shall remain in effect and the supplementary provisions shall be considered as added thereto. Where any Article, paragraph or subparagraph in the General Conditions is amended, voided, or superseded by any of the following paragraphs, the provisions of such Article, paragraph or subparagraph not so amended or voided or superseded shall remain in effect. In the event of any conflict with such General Conditions, the provision of these Supplemental General Conditions will prevail.

1.1 Add/change the following:

1.1.1. Change the first sentence to read as follows: "The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications (aka: Project Manual, Specification Manual, Technical Specifications), Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications (Change Orders) issued after execution of the Contract."

1.1.9 Add the following:

.1 "The term "product" includes materials, systems, and equipment.

.2 The term "provide" includes furnishing and installing a product, complete in place, tested and approved.

.3 The term "building code", and the term "code", refer to regulations of governmental agencies having jurisdiction over the Work at time of permit.

.4 The terms "approved", "required", "as directed", and terms of similar import, refer to and indicate the Work or materials that may be approved, required, or directed by the Architect acting as the agent of the Owner.

.5 The term "similar" is used in its general sense but does not necessarily mean "identical."

.6 The term "shown", "indicated", "detailed", "noted", "scheduled", and terms of similar import, refer to requirements contained in the Contract Documents.

.7 The term "equal" and terms of similar import, refer to a warranty by the Contractor that the type, kind and nature of any substituted product or material or the Work shall be equal to that specified in the Contract Documents and approved in writing by the Architect. The procedure for the Contractor to obtain Architect's approval for such substitutions is set forth in Section 012300"

1.2 Add the following:

1.2.4 “Execute work as per Contract Documents. Make no changes there from without having first received written permission FROM THE ARCHITECT. Where detailed information is lacking, before proceeding with work, refer matter to the Architect for information."

1.2.5 “If the Contractor observes any errors, discrepancies, or omissions in the Contract Documents, he shall promptly notify the Architect, requesting clarification. If the Contractor proceeds with work affected by such errors, discrepancies, or omissions without receiving such clarification, he does so at his own risk. Any adjustments involving such circumstances made by the Contractor, prior to approval by the Architect, shall be at the Contractors risk and the settlement of any complications or disputes arising there from shall be at the Contractor's sole expense."

1.2.6 “In general, the Drawings indicate dimensions, positions, and details of construction; the PROJECT MANUAL describes qualities of material and methods of workmanship. All work described in the PROJECT MANUAL shown on the drawings and all work dependent upon or necessary, shall be executed in a quality workmanlike manner and shall be of the materials best adapted to the purpose where such work or materials are not specifically mentioned."

1.2.7 “Should conflicts occur in or between Drawings and PROJECT MANUAL the Contractor is deemed to have estimated on the more expensive way unless he has asked for and obtained additional written instructions from the Architect before submission of the contractor's proposal as to which method or materials will be required."

1.2.8 “All work and materials shall be the best of the respective kinds specified and indicated. Should any workmanship or materials be required which are not directly or indirectly called for in the PROJECT MANUAL and/or shown on the drawings, but which are necessary for proper fulfillment of the obvious intent thereof, said workmanship or materials shall be the same as similar parts particularly described or delineated." that are detailed, indicated or specified and the Contractor shall understand the same to be implied and provide for it in his proposal as fully as if it were

1.5 Add/change the following:

1.5.1 Change the first sentence to read as follows: "The Architect, the Owner and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications (including those in electronic form), and will retain all common law, statutory and other reserved rights, including copyrights."

1.5.3 Add: “The use of the Contract Documents shall be restricted to the original site for which they were prepared, and publication thereof is expressly limited to such use. Reuse, reproduction, or publication by any method, in whole or in part, is prohibited. Title to the Contract Documents remains with the Architect and Owner without prejudice. Visual contact with the Contract Documents shall constitute prima facie evidence of the acceptance of these restrictions."

1.5.4 Add: "Contractor's Use of Instruments of Service in Electronic Form.

.1 The Architect may, with the concurrence of the Owner, furnish to the Contractor versions of Instruments of Service in electronic form. The Contract Documents executed or identified in accordance with Subparagraph 1.5.1 shall prevail in case of inconsistency with subsequent versions made through manipulatable electronic means involving computers.

.2 The Contractor shall not transfer or reuse Instruments of Service in electronic or machine-readable form without the prior written consent of the Architect.

.3 The Instruments of Service in electronic form are without warranty as to their accuracy or suitability for the purpose of the Contractor's intended use.

.4 Any changes or modifications to the Instruments of Service in electronic form introduced by anyone other than the Architect may result in adverse consequences and the Contractor shall defend, indemnify and hold harmless the Owner, Architect and Architect's consultants against any adverse consequences."

2.2 Add the following:

2.2.3 Add the following to the end of the paragraph: "The Owner shall furnish a preliminary Soils Investigation Report describing the subsurface characteristics of the soil along with recommended design and construction guidelines. The Contractor to follow recommendations and include within his scope of the Work."

3.2 Add the following:

3.2.5 “Maps, soil investigation reports and similar reference data made available to the Contractor are given for the Contractor's information only, and neither the Owner nor the Architect assume any responsibility for Contractor conclusions based on the reference data provided."

3.2.6 “Failure of the Contractor to acquaint himself with all available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work."

3.2.7 "Should conflict occur between the Contract Documents, the Contractor is deemed to have based his estimate upon the more expensive method of performing the Work unless he has requested and received a written decision from the Architect before submission of his proposal."

3.2.8 " "

3.3 Add the following:

3.3.4 “Neither the presence or absence of the Owner or the Architect, nor their authorized representatives, shall relieve the Contractor from any requirements herein."

3.3.5 "The Contractor shall obtain and pay for the services of an independent, licensed surveyor to lay out the Work. The surveyor shall be subject to approval by the
Architect and shall not be a regular employee of the Contractor. As soon as practicable, the surveyor shall certify that the layout is in conformance with the Contract Documents. The Contractor shall furnish a surveyor-certified drawing showing exact locations of all portions of the structure to the Owner and Architect prior to proceeding with construction. All Work that is not correctly located shall be relocated or altered to conform to the Contract Drawings, as the Architect may direct, at no additional cost to the Owner."

3.4 Add the following:

3.4.2 Delete paragraph and add the following: "After the Contract has been executed, the Architect may, at the option of the Owner, consider a formal request for the substitution of products in place of those specified only under the conditions set forth in Section 01600 and other sections of General Requirements (Division 1 of the Specifications). By making requests for substitutions, the Contractor:

.1 Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.

.2 Represents that the Contractor will provide the same warranty for the substitution that the Contract would for that specified.

.3 Certifies that the cost data presented is complete and includes all related costs under this Contract including the Architect's review and redesign costs and waives all claims for additional costs related to the substitution which subsequently become apparent.

.4 Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects."

3.4.5 “Labor shall be performed in best quality and most workmanlike manner, by mechanics skilled in their respective trades. Standards for work required throughout shall be of such grade as will result in first-class work."

3.4.6 “Mechanics whose work is unsatisfactory to the Owner or the Architect or is considered by the Owner or Architect to be careless, incompetent, unskilled or otherwise objectionable shall be dismissed from work under the Contract upon written notice from Owner or Architect."

3.7 Add the following:

3.7.6 “The Contractor shall, before commencing work, verify all grades, lines, levels and dimensions shown on the drawings and shall report any errors or inconsistencies to the Architect. The Contractor shall not proceed until such errors or inconsistencies are corrected."

3.7.7 “The Contractor shall establish and maintain all buildings and construction grades, lines, levels and benchmarks (permanent or temporary) and shall be responsible for accuracy and protection of same."

3.7.8 “The Contractor shall not remove any property line markers or monuments, or data established by the Owner. If such are damaged or removed, the Contractor shall bear cost of replacement."

3.9 Add the following:

3.9.4 "The Contractor shall employ a competent superintendent who shall be in attendance at the Project Site on a full-time basis during the progress of the work until the project is 100% complete including but not limited to; the securing of a TCO and / or C of O that allows Sprouts to open for businss, the Architectural Punch List, and the Commissioning List., The contractor shall also employ the same superintendent for no less than five (5) weeks prior to Grand Opening. The superintendent shall not divide his duties or responsibilities among any other projects that are not a specific portion of this agreement. On grand opening day, the General Contractor's Superintendent and a person representing each major trade (HVAC, Refrigeration, Plumbing, Electrical, and Fire) who are capable of making repairs to their respective systems shall be present."

3.12 Add the following:

3.12.11 "The Architect's review of Contractor's submittals will be limited to examination of an initial submittal and one (1) resubmittal. The Architect's review of additional submittals will be made only with the consent of the Owner after notification by the Architect. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for evaluation of such additional resubmittals."

3.13 Add the following to the end of the original paragraph:

3.13.1 “The Contractor shall be liable for any and all damage caused by him to the Owner's premises. The Contractor shall hold and save the Owner, his agents and representatives,

free and harmless from liability of any nature or any kind arising from any use, trespass or damage occasioned by his operations on premises or third persons."

3.14 Add the following:

3.14.3 “In all cases exercise extreme care in cutting operations, and perform such operations under adequate supervision by competent, skilled mechanics. Openings shall be neatly cut and shall be kept as small as possible to avoid unnecessary damage. Careless and/or avoidable cutting, damage, etc., will not be tolerated, and the Contractor shall be held responsible for such avoidable or willful damage."

3.14.4 All replacing, patching, and repairing of all materials and surfaces cut or damaged in the execution of the work shall be performed by experienced mechanics. Such replacing, repairing and/or patching shall be done with the applicable materials, in such a manner that all surfaces so replaced, etc., will, upon completion of the work, match the surrounding similar surfaces.

4.1 Delete the following:

4.1.2 Delete the word "Contractor."

4.1.3 Delete in its entirety.

4.2 Add the following:

4.2.4 Add the following to the end of the last sentence: ", in which case the Owner accepts full responsibility with the Contractor for the instructions given."

4.2.8 Delete first sentence in its entirety and insert the following: "The Architect will review Change Orders and Construction Change Directives prepared by the Contractor and may authorize minor changes in the Work as provided in Paragraph 7.4."

4.2.12 Add the following: "If work is required in a manner that will make it impossible to produce first class quality work, or should discrepancies appear among Contract Documents, the Contractor shall request interpretation before proceeding with work."

5.2 Add/delete the following:

5.2.1 Delete "within 14 days" in the second sentence, and "or Architect" in the third sentence.

5.2.2 Delete "reasonable and timely" from first sentence.

6.2 Add/delete the following:

6.2.2 Add "and the Owner" after "Architect."

6.2.4 Delete the word "wrongfully."

7.1 Revise the following:

7.1.2 Revise as follows: "A Change Order shall be based on Agreement among the Owner and the Contractor; (delete the word "Architect") (the remainder of the paragraph is acceptable).

7.2 Change the following:

7.2.1 Change to read: "prepared by the Contractor", omit "Architect."

7.3 Add/change the following:

7.3.1 Change to read: "written order prepared by the Contractor", omit "Architect."

7.3.5 Add the words" and the Owner" following the word "Architect".

7.3.6 Add the following: "All change order directives shall be referenced to account numbers as shown on Schedule of Values."

7.3.7 Change "Architect" to "Owner and Architect in all references.

7.3.10 Delete the words "made by the Architect".

7.4 Delete the following:

7.4 Delete the last sentence.

8.3 Add the following:

8.3.4 "When the Contract Time has been extended, as provided for under this Paragraph 8.3, such extension of time shall not be considered justifying extra compensation to the Contractor for administrative costs or other such reasons."

9.2 Add the following:

9.2.1 Add "and the Owner" after "Architect" to the paragraph.

9.3 Add the following:

9.3.1.3 "Unless otherwise required by the Owner-Contractor Agreement or laws of the state in which the project is located, retainage shall be 5%."

9.3.1.4 "Application for Payment shall be made on AIA Form G-702 and G-703, current edition entitled "Application and Certificate for Payment", (high quality PDF with signatures in blue ink to be sent to the Architect for review and signature) utilizing complete provisions provided by the form."

9.3.2.1 Partial Lien Releases are required to be submitted with Pay Applications for any subcontractor whose materials total $5,000.00 or more. Each Pay Application will not be processed unless an Unconditional Lien Release is provided for the amount that was submitted from the previously approved Pay Application. Additionally, an Unconditional Lien Release must be submitted with the Final Payment request.

9.3.2.2 The Contractor agrees to accompany all payment requests, except the first, with unconditional lien waivers from all subcontractors and material men pertaining to all the work performed and all materials provided with respect to previous payments received by Contractor. The Contractor further agrees that each subcontract (Which, for the purpose of this paragraph, includes both contracts with subcontractors and material men) shall contain an express provision, satisfactory in form and content to the Owner, whereby such subcontractor or material men expressly agrees that, for the benefits of the Owner, it waives all rights to file mechanics liens with respect to any unpaid services or materials provided by it, as specified by current State statutes. Such subcontractor or material men shall give written notice to the Owner of such non-payment for such materials and services, which notice shall include a specific detail listing of the services and materials with respect to which payment has not been made. The Contractor further agrees that the Owner shall have the right to issue checks made jointly payable to the Contractor and any subcontractor or material men claiming not to have been paid for services or materials provided for which Contractor has been paid. If any liens are filed against the Owner's property, the Owner may, at their option, require the Contractor to immediately provide a bond in accordance with State requirements. Final lien waivers, stating "Unconditional Upon Final Payment', from all subcontractors and material men shall accompany the final payment request prior to approval for release of construction retention funds.

9.5 Change the following:

9.5.1.1 Change to read: "Defective work is not remedied, or failure to there being remedial action within 5 days following written notification."

9.8 Add/change the following:

9.8.2 Revise second line to read, "the Architect shall prepare and submit to the Contractor and the Owner a comprehensive list."

9.8.4 Add "The Contractor shall reimburse the Owner by deductive Change Order, for the Architect's additional services made necessary by the Contractor's failure to finally complete the work within fourteen days from substantial completion".

9.10 Add the following:

9.10.2 Revise the following: "…, to indemnify the Owner against such lien" to read " ... to indemnify the Owner against such lien as a condition precedent to receiving any further payment on account of the work of such contractor."

9.10.2.1 “Neither the final payment nor the remaining retained percentage shall become due, until after all requirements, listed in Section 01700 Contract Closeout, have been 100% completed."

10.0 Add the following:

10.1 Add the following: "except as otherwise provided in the Contract Documents."

10.2 Add the following:

10.2.9 “The Contractor shall be responsible for all existing structure and/or improvements, both above and underground, including the finishes thereof (both exterior and interior) within the adjoining working areas, and shall provide adequate protection therefore, either by barricades, covering or by temporary removal. Any existing structures and/or improvements damaged during construction shall be repaired and/or replaced with materials, workmanship, fixtures or equipment of the same kind, quality and size as required by the Contract Documents. Any materials or equipment temporarily removed and damaged shall be re-erected or installed in an approved manner."

11.1 Add/delete the following:

11.1.1 Delete wording in subparagraph in its entirety and insert the following: "Do not commence work until required insurance has been obtained and paid for, nor until insurance policies have been approved by Sprouts as to a company or companies licensed to do business in the state in which the project is located, amount and coverage form.* Do not permit any subcontractor to commence work on subcontract until such insurance has been so obtained and has been approved by Sprouts.

*Contractor's insurance carrier must be an "A" A.M. Best rated carrier.

The Contractor shall furnish the Owner certificate evidencing such insurance, list Sprouts and its subsidiaries as an additional insured on all policies required and shall arrange with each insurance company to give Sprouts thirty day’s notice of all renewals, cancellations and major changes in the policies.

Furnish one copy of Certificates herein required for each copy of the Agreements' specifically set forth and evidence of all coverage required by Subparagraph 11.1 and 11.2. The form of the Certificates shall be in conformance with the enclosed sample. Furnish to Owner's agent copies of any endorsements that are subsequently issued amending coverage or limits."

11.1.2 To this subparagraph, add the following: "11.1.2.1 The insurance required by Subparagraph 11.1.1 shall be written for not less than the following, or greater if required by law:

.1 Worker's Compensation:
State Statutory
Applicable Federal Statutory
Employer's Liability $ 1,000,000 / $1,000,000 / $1,000,000

.2 Comprehensive general Liability (including Premises-Operation; (Contingent Liability, Contractual Liability, Independent Contractor's Protection; and Products and Completed Operation)"

Bodily Injury	$1,000,000	Each Occurrence
	$2,000,000	Annual Aggregate Occurrence
Property Damage	$1,000,000	Each Occurrence
	$2,000,000	Annual Aggregate Occurrence

Products and completed operations to be maintained insured for two years after final completion. Property Damage liability Insurance will provide X, C, or U coverage as applicable.

.3 Contractual Liability:

Bodily Injury	$1,000,000	Each Occurrence
	$2,000,000	Annual Aggregate Occurrence
Property Damage	$1,000,000	Each Occurrence
	$2,000,000	Annual Aggregate Occurrence

.4 Personal Injury, with Employment exclusion deleted:
$2,000,000 Annual Aggregate Occurrence

.5 Comprehensive Automobile Liability:
$1,000,000 Combined Single Limit

.6 The Contractor shall provide the limits of liability by a combination of the above described policy forms and an Umbrella Excess Liability policy.

Contractor's excess liability, umbrella form, bodily injury and property damage combined:
$5,000,000 Aggregate Occurrence

.7 Sprouts and the Landlord needs to be named as additionally insured.

.8 Sprouts Farmers Market shall be the certificate holder.

11.1.3 Add the following:

.1 The Contractor shall, prior to starting work, furnish one copy of Certificates herein required for each copy of the Agreement which shall specifically set forth evidence of all coverage required by Subparagraph 11.1.1,

.2 “11.1.2 and 11.1.3. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits."

11.2 Add /delete the following:

11.2.1 Delete all wording and replace with: "The Contractor shall be responsible for purchasing and maintaining Owner's Liability insurance with the same limits as Contractor's Comprehensive General Liability. Including Bodily Injury, Property Damage and Personal Injury. (Broad Form Property Damage Endorsements).

11.4 Add the following:

11.4 "Performance Bond and Labor and Material Payment Bond: Add the following subparagraphs to this article:

11.4.3 “The Contractor is required, as a condition precedent of the execution of the Contract, to furnish bond in a penal sum of one hundred percent (100%) of the total amount payable by the terms of the Contract and pay all premiums for such bonds."

11.4.4. “Bonds shall be in accordance with State Requirements with amount shown equal to 100% of the total amount payable by terms of the Contract. Surety shall be company licensed to do business in state in which work is located and shall be acceptable to Owner. Bond amount shall be increased to include any Change Order added to the Contract to 100% total value amount of each Change Order. Bond limitations shall be one year except where state laws and statutes require additional time limitations."

12.1 Add the following:

12.1.1 Add "or the Owner's" after "Architect's" to paragraph.

12.1.2 Add "or the Owner" after "Architect' to paragraph.

12.3 Add the following:

12.3 Add the following to the end of the paragraph: "Nonconforming work shall be deemed accepted only if the Owner does so expressly and in writing."

13.1 Add the following:

13.1.1 “Nothing contained in the Contract Documents shall be construed as authority for violation by the Contractor of any applicable codes or ordinances which shall take full and complete precedence of anything herein contained to the contrary."

13.1.2 “In the event that the building inspector or other public official requires that additional work be done, or that the work under the Contract Documents be modified in any way, the Contractor shall notify the Architect and the Owner in writing of the requested change. The Architect will review the requested change with the Owner and advise the Contractor in writing. Any such work performed without written permission shall be at the expense of the Contractor performing such work."

13.2 Add the following:

13.2.3 Repair all defects and/or damage resulting from faults in workmanship or materials that develop during specified guarantee periods. Disruption of store business shall not be permitted. Contractor shall complete repair work entirely at his own expense within five days of receipt of written notice. General Contractor must coordinate work schedules with Owner prior to commencement of any repair and/or warranty work.

13.2.4 Emergency/Warranty repairs "Note: Telephone communication will constitute official notification. This will be followed up by written notification. Failure to respond within one hour gives the Owner the right to have repair work performed. Charges for that work shall be billed to the General Contractor upon completion of any warranty and/or repair work. The General Contractor shall notify Owner in writing when the work is completed".

13.4 Add the following:

13.4.3 "The invalidity of any part or provision of the Contract Documents shall not impair or affect in any manner whatsoever, the validity, enforceability or effect of the remainder of the Contract Documents."

13.5 Add the following:

13.5.1 Add "and the Owner" after "Architect" to paragraph.

13.5.2 Add "and the Owner" after "Architect" to paragraph.

14.1 Delete the following:

14.1.3 Delete the words "and damages" at the end of this paragraph.

14.2 Delete the following:

14.2.1.1 Delete "repeatedly".

14.2.1.3 Delete "repeatedly".

14.2.1.4 Delete "substantial".

15.1 Add the following:

15.1.5.3 "Claims for increase in the Contract Time shall set forth in detail in circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such case of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim."

15.1.5.4 "The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor."

15.4 Add the following:

15.4.1.2 "After appointment of the arbitrator or arbitrators, the parties to the arbitration shall have the right to take depositions and to obtain discovery regarding the subject matter of the arbitration and, to that end, to use and exercise all of the same rights, remedies, and procedures, and be subject to all of the same duties, liabilities, and obligations in the arbitration with respect to the subject matter thereof, as if the matter of the arbitration were pending in a civil action before a Superior Court of the State."

END OF SECTION 007300

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SECTION 007400
SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section is supplementary to the Instructions to INVITED BIDDERS AlA Document A201 (latest edition). AlA Document A201 is not contained within these Specifications but is to be considered a part of the bidding instructions. Contractor shall obtain a copy of and be familiar with this document.

1.02 EXAMINATION

A. Before submitting a Proposal. The Invited Bidder shall carefully examine the Drawings and Specification Manual (Bid Documents), visit the site of the work and fully inform themselves as to all existing conditions and limitations and shall Include in the Proposal, the cost of all Items necessary in the construction of the project. The Invited Bidder shall not be allowed any extra compensation by reason of any matter or thing, concerning that which such the Invited Bidder might have fully informed himself prior to the bidding.

B. Interpretations, Addenda
   1. Should an Invited Bidder find any ambiguity, inconsistency or error in the Drawings and Specification Manual or be in doubt as to their meaning, the Invited Bidder shall at once notify the Architect in writing via fax and email who will issue a written addendum response to all Invited Bidders.
   2. Any addenda issued by the Architect during the time of bidding are to be Included in the proposal from the Invited Bidder and shall become a part of the Bid Documents. The Invited Bidder shall acknowledge receipt of addenda on the proposal form in the space provided.
   3. Addenda will be mailed, emailed or delivered to each Invited Bidder, person or firm recorded by the Architect as having received the Construction Documents for bidding and at a designated plan service (if used).

C. Substitution of Materials
   1. Generally, no substitutions from the materials and products specified by this project manual are allowed. All substitution requests must be-submitted in writing, prior to bidding, to the Architect per the requirements of Section 012300 and 016000 of this Project Manual. Approved substitution requests will be distributed as addenda to all Invited Bidders in writing by the Architect.

D. Proposals
   1. the completed form shall be without alterations or erasures. The Included Bid Schedule of Values must be fully executed and submitted simultaneously with the Proposal Form.

2. The Proposal Form shall bear the name of the Invited Bidder. Where an Invited Bidder is a corporation, a corporate proposal must be signed in the legal name(s) of the corporation followed by the name of state of incorporation and the legal signature of a corporate officer authorized to bind the corporation to a contract.
3. Proposals shall be addressed to Sprouts Farmers Market and delivered via email by the dates specified in the invitation to bid.
4. Time is of the essence and consideration of such shall be made in the awareness of this on the bid proposal form. The project shall be completed to the point of Substantial Completion as defined in The General Conditions of the Contract for Construction and the Certificate of Occupancy shall be issued within_____ (including week days and weekend days}) from five (5) days following the Notice of Authorization to Proceed; In the event that Contractor does not achieve Substantial Completion within the specified period, then, in addition to any other rights or remedies of Owner, Contractor shall be liable for damages of $5,000.00 per calendar day as and for liquidated damages and not as a penalty. Each Owner and Contractor acknowledges that time is of the essence and such delay will result in lost income and profits to Owner. The exact amount of which will be difficult to ascertain, but that the foregoing represents a reasonable and good faith estimate of the amount thereof.
5. All bids shall remain firm for a period of sixty (60) calendar days after the date of bid opening and the Invited Bidder shall be prepared to enter into a contract for construction and begin construction within five (5) calendar days after date of Notice of Authorization to Proceed.
6. to bid opening but may not resubmit them. No proposal may be modified or withdrawn after the bid opening except where the Award of the Contract for Construction has been delayed for more than sixty (60) days.
7. The building permit(s) cost or development fees assessed by governmental authorities shall be excluded from the base bid. These additional costs may be added to the contract sum by Change Order. No profit or overhead shall be added by the General Contractor to this Change Order. Any taxes assessed by the issuer will be included in the permit cost. Within 72 hours of receiving the Building Permit, the General Contractor shall provide a scanned copy via email distribution to the Sprouts Project Manager, as well as the Sprouts Construction Coordinator. General Contractor shall perform all work to comply with applicable building codes and regulations. The General Contractor shall procure construction monitoring systems via direct buy account, install all security monitoring camera systems to full operation, and send login information to Sprouts Farmers Market within 72 hours of Notice to Proceed.

E. Pre-Bid Meeting Notes:
1. Final pre-bid meeting notes will become a part of the construction documents and project manual (specifications) and are to be incorporated into the final bid and construction process.

F. Bid Security
1. Bid security is not applicable.

G. Invited Bidders I General Contractors
1. Only those General Contractors selected and invited to bid by the Owner shall be permitted to submit proposals.

H. General Contractor Proposed Subcontractors
   1. The Invited Bidder (General Contractor) shall submit to Owner, within forty-eight (48 hours) (2 working days) of bid opening, if requested by the Owner, per the enclosed subcontractor list (Section SL), listing single name only for each branch of the work.
   2. The Invited Bidder (General Contractor) shall submit to Owner, within forty-eight (48 hours) (2 working days) of bid opening, the completed “Concrete Subcontractors Qualification Statement” in Section 033100.
   3. The Owner reserves the right to reject any proposed subcontractor(s). Subcontractors proposed by the bidder must be used on the work for which they are proposed and shall not be changed without the written approval by the Owner. Rejection of proposed Subcontractors shall be pre-emptory, and the Owner will not be expected or required to state cause

I. Bid Schedule of Values
   1. At the time of bid proposal submittal, the Invited Bidder shall submit a complete Bid Schedule of Values. This schedule is included herewith, and its format must be adhered to strictly.

J. Copies Furnished
   1. The successful Invited Bidder (General Contractor) will be furnished with one (1) set of bond paper plans and one (1) set of Master Specification manual originals (Construction Documents), one (1) Fixture Cut Sheet Book and one (1) set of Prototype Store Program originals free of charge.
   2. These drawings and specification manuals will be labeled "Construction Sets"; the Construction documents will include all pre-bid addenda. No other previously issued drawings or specification manuals shall be allowed for use in construction of the project. The General Contractor will print "blackline" construction drawings and provide "red" covers for bound specifications.

K. Contractor's License Law
   1. The General Contractor shall comply with and require all subcontractors to comply with all Federal, State and City Contractor license laws and be duty Registered and licensed there under as required.

L. Performance Bond
   1. sureties as they may approve. The General Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract for Construction. The General Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his Power of Attorney indicating the monetary limit of such power.
   2. The General Contractor shall furnish the name, address and rating of the bonding company on the proposal form. Owner reserves the right to reject any proposed bonding company without stating cause. In this event the General Contractor shall provide an alternate bonding company selection acceptable to the Owner.

3. Bonds shall conform to state statutes regarding performance bond and labor and material payment bond with amount shown on each part equal to 100% of the total amount payable by terms of the Contract for Construction. The surety company shall be licensed to do business in state in which construction project is located and shall be acceptable to Owner. Bond amount shall be increased to include any Change Order (s) added to the contract to 100% total value amount of each Change Order. Bonds will be recorded along with a copy of the construction contract in the County Recorder Records by the General Contractor with written proof thereof submitted to the Owner.

M. Summary of Work
1. See Section 011000, Summary of Work, for description of the work.
2. Note certification plan of building square footage by surveyor providing the building outside of wall dimensions for each wall outside corner to outside corner or if a common wall to centerline of the common wall. See also Section 011000.1.16.

N. Social Security Act
1. The General Contractor agrees to comply with and to require all of his subcontractors to comply with all the provisions of the Act of Congress approved August 14, 1935, known and cited as the Social Security Act and also the provisions of the act of the State Legislature approved and known as the State Unemployment Compensation Law and all other laws and regulations pertaining to labor and workmen and all amendments to such data and the contractor further agrees to indemnify and save harmless the Owner of and from any and all claims and demands made against it by virtue of the failure of the contractor or any subcontractors to comply with the provisions of any or all of said acts and amendments.

O. Sales and Use Tax
1. The General Contractor agrees to comply with and to require all of his subcontractors to comply with all the provisions of applicable state sales excise tax law and compensation use tax law and all amendments to same. The contractor further agrees to indemnify and save harmless the Owner, of and from any and all claims and demand made against it by virtue of the failure of the General Contractor of any Subcontractor to comply with the provisions of any of all said laws and amendments.

P. Waiver of Liens
1. The General Contractor is responsible for the payment of all bills for labor and materials furnished by the subcontractors, the suppliers, and the General Contractor on this project The General Contractor shall deliver to the Owner, as outlined in the Supplementary General Conditions, Unconditional Lien Waivers and/or Releases from himself and from each of his subcontractors and suppliers, and at such time he shall certify that he is submitting such lien waivers for all subcontractor and suppliers involved.
2. If any liens are filed against the Owner's property, the Owner may, at his option, demand the General Contractor immediately provide a bond in accordance with state statutes.
3. Partial Lien Releases are required to be submitted with Pay Applications for any subcontractor whose materials total $5,000.00 or more. Each Pay Application will not be processed unless an Unconditional Lien Release is provided for the amount that was submitted from the previously approved Pay Application. Additionally, an Unconditional Lien Release must be submitted with the Final Payment request.

4. review the work with the General Contractor to determine whether or not Substantial Completion. Status has indeed been achieved.
5. Where Substantial Completion is achieved final payment requests will be considered for approval (not including retention funds) and the Architect shall prepare a Punch List. (Punch List does not automatically indicate Substantial Completion is achieved). The General Contractor shall complete all items noted on the Punch List to the satisfaction of the Owner within 15 calendar days.
6. Upon the satisfactory completion of the Punch List, with Substantial Completion achieved, a Certificate of Occupancy issued, and all close-out package items completed to the satisfaction of the Owner, construction retention funds shall be approved for payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Work by Others.
4. Use of Premises.
5. Owner Furnishing and Equipment Delivery Schedule
6. Storm Water Pollution Prevention Plan (SWPPP)
7. Construction Cameras

1.02 PROJECT INFORMATION

A. Project Identification: Sprouts Farmers Market, Tallahassee, FL.
1. Project Location: 3111 Mahan Drive, #18, Tallahassee, FL 32308.

B. Owner: Sprouts Farmers Market, 5455 East High Street, Suite 111, Phoenix, AZ 85054.
1. Owner's Representative: Keevin Simpson, Telephone: 480-814-8016, Keevin.Simpson@Sprouts.com

C. Architect: Larson Design Group, Inc., 495 N Keller Road, Suite 101, Maitland, FL 32751, Phone: 689-710-0035.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
1. General Scope of Work: Contractor shall provide services to complete new work at the project address, as directed by Owner, and as covered by the project documents. Contractor shall also provide all work necessary to modify, and / or supply new utilities to project area for use by Owner. Off-site work is not a part of this contract. See plans for Scope of Work.

B. Type of Contract:
1. Project will be constructed under a general construction contract.

C. The contractor is responsible for familiarizing himself with the contract documents.

D. The contractor shall verify all grades, levels, conditions and dimensions and shall make all necessary measurements at the job site. No extra charge will be allowed because of differences between actual measurements and the dimensions indicated on the drawings. Any difference noted shall be reported to the Owner for consideration before proceeding with the Work. The work under the Base Bid of the Contract/Proposal shall include all work indicated or specified within the Contract limit lines unless the work is specifically indicated as "Not in Contract", "By Owner", "By Others".

E. The contractor is responsible for all work which may be necessary to provide, connect, and install all water, fire line, gas, sewer, telephone, electrical service, or any item or component to the building and site, including, but not limited, to replacement of paving, roof, walls or floor to meet the requirements of governmental authorities. All utilities are to be extended to a minimum 5 feet outside of building and connected to site utilities unless noted otherwise on the drawings.

F. Immediately upon signing the Contract for Construction, the General Contractor shall sign (2) two complete sets of Drawings and Specification Manuals (for Specification Manual, signature to be applied on Table of Contents sheets thereof) as additional evidence of his understanding of the work called for with such Alternatives and Amendments as specifically mentioned in the Agreement. These shall become Contract Drawings and Contract Specification Manual. File one set with the Owner and keep one set at the job site at all times during the progress of the work as the General Contractor's copy.

G. In case of a discrepancy between Contract Documents, the Architect is to be notified so a written clarification may be issued. If Architect is not notified prior to bid date, refer to General Conditions, Article 1, Subparagraph 1.2.3.

H. The work under the Base Bid of the Contract/Proposal shall include all work indicated or specified within the Contract limit lines unless the work is specifically indicated as "Not in Contract", "By Owner", or "By Others". Work described in the Contract Documents includes the furnishing of all labor, materials, equipment, and services specified or indicated on the drawings and related documents, or reasonably inferred therefrom, for the construction of a complete and usable facility.

I. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this contract with work performed under separate contracts. The General Contractor is responsible for coordination of the project with work by others where Owner building abuts adjacent property(s) or buildings, but not limited to, finish grades, asphalt, utility connections, landscape, site lighting, parking, paint striping.

1.04 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 0, and other Division 1 Specification Sections, apply to this Section.

B. The Contract Documents consist of the Owner-Contractor Agreement, the General Conditions of the Contract, the Drawings, the Specifications, and all addenda issued prior to and all modifications issued after execution of the Contract. A modification is either a written amendment to the Contract signed by both parties, a change order, a written interpretation issued by the Architect (RFI, ASI) or other authorized representative of the Owner, or a written order for a minor (no cost) change to the work issued by the Owner's representative and copied to the Architect.

C. Drawings may consist of Civil, Landscape (where applicable), Architectural, Structural, Mechanical, Plumbing, Electrical, and EMS (including fire protection where applicable) as listed in the Index of Drawings and any addendum.

D. The Drawings show the materials to be used and the form, fabrication and assembly. In all cases, measured dimensions taken at the project site shall take precedence over scaled dimensions.

1.05 WORK BY OTHERS

A. Certain items of equipment and/or elements of the construction may be excluded from the Contract for Construction, and if so, are indicated on the Drawings and identified herein. Installation thereof may be performed while the General Contractor's work progresses. The General Contractor shall cooperate with the Owner to facilitate the expeditious installation of such items.

B. Other construction activities, under direct supervision by the Owner, are contemplated in the same area of work during the construction period established for this Agreement. All Contractors on the work which may begin progress during the same period of time shall have equal rights to use the roads, grounds, areas, etc., and shall coordinate activities which come into conflict so as to determine the affect of his work of the additional activity, which is not part of this Agreement; and shall adequately adjust his price accordingly. No request for additional compensation for any reason, in this connection, will be considered.

1.06 GENERAL REQUIREMENTS

A. The General Contractor shall send proper notices, make all necessary arrangements, and perform all services required in the care and maintenance of all public utilities. The General Contractor shall, during the construction period and until final acceptance of the work as a whole by the Owner, assume all responsibility concerning the same for which the Owner may be liable.

B. Prior to beginning work of the Contract, the General Contractor shall meet with the Owner to determine procedures regarding access to and use of the site, exterior staging and storage areas, special site conditions, and all other restrictions regarding the use of the site areas surrounding the construction.

C. The General Contractor shall repair all public and private streets, drives, curbs, walks, and other improvements where disturbed by work of, or related to, building operations, leaving them in as good condition after completion of the work as before operations started, in accordance with rules, regulations, and specifications of the public agencies having jurisdiction.

D. Access roads and fire department access roads shall be installed per authorities of jurisdiction.

E. Access roads and fire-lanes on and about the site shall be kept open and free at all times, except moving traffic, for passage of emergency vehicles.

1.07 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project or as indicated on Drawings by the Contract limits.
   1. Driveways and Entrances: Keep driveways, loading areas, walkways, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries of Owner provided equipment or materials so that the Contractor can unload and store the materials in a weather tight and secure area on site.
      b. Prior to beginning work of the Contract, the General Contractor shall meet with the Owner to determine procedures regarding access to and use of the site, exterior staging and storage areas, special site conditions, and any other restrictions regarding the use of the site areas surrounding the construction.
   2. The General Contractor shall endeavor at all times to maintain as low a level of construction noise as possible in order not to create a disturbance in the neighborhood.
   3. Confine operations at site to areas and times permitted by Law, Ordinances, Permits and Construction Documents.
   4. Do not unreasonably encumber site with materials or equipment.
   5. Schedule work to minimize disruption of the Owner and adjoining tenants use of adjacent facilities.
   6. Assume full responsibility for protection and safekeeping of products stored on premises and persons on premises.
   7. Move any stored products, which interfere with existing operations of the Owner and/or adjacent tenants.
   8. Obtain and pay for use of additional storage or work areas needed for operations.
   9. Do not load structure with weight that will endanger structure.
   10. Clean up all work daily and keep all work and trash confined so as not to encumber existing tenants.

1.08 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products as indicated on drawings and specifications. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

1.09 OWNER AND TENANT OCCUPANCY REQUIREMENTS

A. Owner and/or Tenant Occupancy of Completed Areas of Construction: Owner / Tenant reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
   1. Obtain a Certificate of Occupancy or a Certificate of Completion from authorities having jurisdiction before Owner occupancy.
   2. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.10 PARTIAL OCCUPANCY

A. General Contractor shall establish priority scheduling without appreciably affecting the completion time for the entire project. Coordinate completion times with the Owner and / or Tenant.

B. Schedule early completion of designated areas for Owner and / or Tenant usage prior to substantial completion of entire project in accordance with schedule or as designated during construction.

C. Owner and / or Tenant will occupy designated areas (determined at later date for purpose of moving material and fixtures and preparing for the installation).

D. General Contractor shall provide access for Owner and / or Tenant personnel.

1.11 DISPOSITION OF UTILITIES

A. In accordance with the General Conditions and when authorized in writing by the Owner Representative, extra work may be ordered. Claims for additional compensation, on account of extra work done, will not be recognized unless such extra work has been authorized in advance and writing by the Owner Representative.

1.12 DISPOSITION OF UTILITIES

A. The Contractor shall perform such extra work and charge the Owner at actual cost of labor and materials. The General Contractor shall have the right to add not more than the amounts indicated on the Proposal Form.

B. For work omitted from Contract: If Contract Agreement has been previously increased by Change Order for additional work, then overhead and profit will be deducted for omitted work; if revised Contract Sum will be less than original Contract amount, then overhead expenses and profit will not be deducted as part of the deductive Change Order for work omitted.

C. Where extra work involves both added and omitted work, the overhead and profit figures specified above shall be added only to the increased amount over the original Contract sum.

1.13 OWNER'S FURNISHING AND EQUIPMENT DELIVERY SCHEDULE

A. Within 5 working days after award of contract, the General Contractor shall submit to Owner a schedule of all delivery dates for Owner's equipment as indicated on the equipment coordination schedule. Owner will coordinate their equipment and cabinetry deliveries with the General Contractor's schedule dates. Should, during the course of construction, the General Contractor need to revise the scheduled delivery dates of any Owner furnished equipment, Owner will try to accommodate the General Contractor's wishes. If Owner is unable to revise their delivery dates, the General Contractor will be held responsible for all additional costs related to storage, extra shipping, re-advertising, additional insurance**(coverage up to $10,000,00 [TEN THOUSAND] dollars),** protection from theft and/or damage, etc., that may be necessary. The request for Owner to modify the delivery dates must be in writing. Owner will determine who handles the equipment and where it is to be stored with General Contractor concurrence.

1.14 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. Contractor shall comply with all applicable water quality laws, statutes, ordinances, guidelines, manuals, and standards, enforced by National, State, and Local jurisdictions, including all applicable amendments and modifications.

B. Contractor shall immediately notify Construction Manager/Owner of any violations of these requirements, and immediately correct such violations.

C. All Work performed by Contractor that is not in conformance with applicable requirements, shall be redone until it is in compliance with applicable requirements at Contractors sole expense, and with no impact on the construction schedule.

D. The SWPPP (if required) is to be included as part of the Contract Documents.

1.15 CONSTRUCTION CAMERAS

A. Contractor shall have construction cameras installed at designated locations on the project for continuous monitoring. Contact: J.P. Schaaf, OxBlue Corp., wk. (404) 554-1461 or (416) 848-3891, mo. (678) 951-3313, e-mail: jpschaaf@oxblue.com

B. On "Build-to-Suit projects, allow for one camera at start of sitework and at least an additional two cameras when roof is completed. If no power is available at beginning of sitework, provide for manufacturer's solar array. **Payment for OxBlue camera service shall be included in the Contractor's bid to the Owner.**

C. On Tenant Improvement projects, provide at least two interior cameras and one exterior camera, if there is exterior work, at start of Work. **Payment for OxBlue camera service shall be provided by Sprouts Farmers Market.**

D. Contractor shall adhere to the following procedure:
1. Immediately upon award of the Project:
   a. Submit project information at www.oxblue.com/order

b. Contractor to provide 110v power or procure OxBlue Solar Power Equipment prior to commencing construction. OxBlue to provide cellular data connectivity.
c. Procure camera by signing an OxBlue quote and agree to give full image access to Sprouts Farmers Market.
d. Sprouts Farmers Market and OxBlue have agreed on discounted pricing for Cameras and Service.

2. Prior to commencing construction:
   a. Order camera(s) a minimum of 10 days prior to commencing construction. Orders submitted less than 10 days prior to construction shall require a $250 expediting fee per camera.
3. Camera installation:
   a. Exterior and Interior Camera locations must be approved by Sprouts.
   b. Cameras shall be installed, tested and fully functional prior to commencing construction. Contractor shall maintain power to the camera and ensure the camera is functional until the Friday before Grand Opening week.
   c. Install Exterior Cameras a minimum of 12’ above finished floor elevation (higher preferred) and in a location which provides an unobstructed view of the site and the front elevation of Sprouts.
   d. Install Interior Cameras:
      1) One camera shall be located in the Vitamin Corner with a maximum view of the Sales Floor.
      2) One camera shall be located at the rear corner on the Deli side, above the Self Service Meat with a maximum view of the Sales Floor.
   e. The General Contractor shall send notice and login information to Sprouts Farmers Market within 72 hours of Notice to Proceed.
4. At completion of Project:
   a. Return camera and all accessories to OxBlue within 7 days of completing project. Shipment must use original OxBlue packaging materials. Insure package for $4,000 dollars.
5. For additional information and any questions, please contact: OxBlue Corporation, 814 Bellemeade Avenue NW, Atlanta, GA 30318, Phone: 888-849-2583 or 404-917-0200, Email: jpschaaf@oxblue.com
   a. Observe rules and regulations governing the respective utilities in executing all work under this heading.
   b. Adequately protect active utilities from damage and remove or relocate only as indicated or specified.
   c. Remove, plug or cap inactive and abandoned utilities encountered during the work. If there are no specific requirements, plug or cap such utility lines at least 5 feet outside of new building walls or as required by local regulations, and indicate such on Record Drawings.

1.16 ARCHITECTURAL AND ENGINEERING SERVICES

A. It is understood that normal architectural and engineering liaison for the purpose of interpretation of the Construction Documents is provided for by the Owner. Should any services of the Architect be required to assist in the corrections of errors or omissions in construction by the General Contractor, or services of the Architect be required because of changes in structure or equipment where the General Contractor has requested approval of substitute methods or materials, these services will be provided by the Architect at his standard hourly rates and shall be paid for by the General Contractor.

1.17 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations and scheduled on Drawings.
   3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

D. In the preparation of the Specification Manual an effort has been made to segregate the various branches of the work under headings, by trades. This is done only for convenience and shall not relieve the General Contractor of the responsibility of furnishing every item indicated or specified whether properly segregated or not.

E. No responsibility will be assumed by the Owner or the Architect for omissions or duplications by the General Contractor in the completion of the Contract due to any alleged error in the arrangement of the material in the Specification Manual nor shall any such segregation of work and materials operate to make the Architect an arbiter in defining limits to the Agreements between the General Contractor and his Subcontractors or Suppliers.

F. The misplacement, addition or omission of any letter, word or punctuation, or lack of capitalization of a word, shall in no way damage the true spirit, intent, or meaning of these Specifications.

G. The word "shown", "indicated", "noted", "scheduled", or words of like effect shall be understood to mean that reference is made to the Drawings accompanying these Specifications.

H. Where reference herein is made to colors or finishes "as selected" the reference is to the Architect.

I. Reference to known standards within the Specification Manual shall mean and intend the latest edition or amendment published prior to the date of this Specification Manual, unless specifically specified otherwise, and to such portions of it that relate and apply directly to the material or installation called for on the Project.

1.18 SAFETY REQUIREMENTS

A. These Construction Documents, and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the federal laws, including but not limited to, the latest amendments of the following:

B. Williams-Steiger Occupational Safety & Health Act of 1970, Public Law, 91-596.

C. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.

D. Part 1518 - Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.

1.19 QUALITY ASSURANCE

A. Contractors License Law General Contractor shall comply with, and require all Subcontractors to comply with, State and Municipal Contractor's license laws and be duly registered and licensed thereunder.

B. Approved applicators -Where specific instructions in these specifications require that a particular product and/or material(s) be installed and/or applied by an approved applicator of the manufacturer, it shall be the General Contractor's responsibility to ensure that any Subcontractors used for such work be approved applicators.

C. Watertight/Weathertight-Anything in the Construction Documents not withstanding, the General Contractor accepts the responsibility of constructing a watertight, weathertight project. Include all flashing and sealant joints required whether or not shown in the construction drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SECTION 012100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Unit-cost allowances.

B. Inspecting and testing allowances.

1.02 SELECTION AND PURCHASE

A. At the earliest practical date (not later than 14 calendar days) after award of the Contract, advise Architect and Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

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

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

1.03 SUBMITTALS

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

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

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

1.04 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.05 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site. Qualify allowance cost to be very clear on what is included and excluded.

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

1.06 INSPECTING AND TESTING ALLOWANCES

A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.

B. Costs Not Included in the Inspecting and Testing Allowances:
   1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
   2. Costs of testing services used by Contractor separate from Contract Document requirements.
   3. Costs of retesting upon failure of previous tests as determined by Architect.

1.07 PERMIT COST ALLOWANCES

A. Costs to include direct costs relating to permits required by the regulatory jurisdictions.

1.08 UNUSED MATERIALS

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

B. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

1.09 EXAMINATION

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

1.10 PREPARATION

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

1.11 ALLOWANCES SCHEDULE

A. Allowance No. 1: $TBD

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012100

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SECTION 012200
UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

1.02 DEFINITION

A. Unit price is an amount proposed by bidders, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.03 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.04 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.05 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Assist by providing necessary equipment, workers, and survey personnel as required.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit process and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

1.06 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

1.07 SCHEDULE OF UNIT PRICES

A. Item: TBD; Section TBD.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012200

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 GENERAL REQUIREMENTS

A. Substitutions are to be proposed and accepted only during bidding.

B. Substitutions indicated/proposed on shop drawings will not be accepted.

1.03 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.04 DEFINITIONS

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

B. The cost or credit for each substitution is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.05 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
2. Agrees to provide the same warranty for the substitution as for the specified product.
3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
4. Include as part of each substitution, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of substitution.
5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number, and any additional required identifiers established in Contract Documents.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.
         4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
         5) Description of Substitution.
         6) Reason why the specified item cannot be provided.
         7) Differences between proposed substitution and specified item.
         8) Description of how proposed substitution affects other parts of work.
      c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
         1) Physical characteristics.
         2) In-service performance.
         3) Expected durability.
         4) Warranties.
         5) Include, as appropriate or requested, the following types of documentation:
            a) Product Data:
            b) Samples.
            c) Certificates, test, reports or similar qualification data.
      d. Impact of Substitution:
         1) Savings to Owner for accepting substitution.
         2) Change to Contract Time due to accepting substitution.

D. Limit each request to a single proposed substitution item.

1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION OF MATERIALS

A. Substitutions are not permitted unless approved during bid process by addendum. If a substitution is proposed, then the (Contractor to provide justification statement), Substitution must be of equal or greater quality than the product it is proposed to replace. At no time will Owner pay additional costs associated with the aforementioned substitution

B. Do not submit substitutions as shop drawings during construction.

C. Verify product availability and lead time for specified products prior to bid as these will not be considered acceptable reasons for substitution after bids close.

D. When a specific manufacturer, trade name or material is specified, or indicated, it is to establish a standard of quality and shall not be construed as limiting competition. If the General Contractor desires to use a manufacturer, trade name or material other than that specified, he shall request approval of such substitution, in writing to the Architect. Requests for substitutions shall be in the hands of the Architect no later than seven (7) days prior to the stated date of bidding as identified in the Contract Documents. Items found acceptable for bidding will be approved by a duly authorized Addendum issued by the Architect. Substitutions will only be considered if they are prepared on a copy of the "Substitution Request Form" attached and submitted completely executed seven (7) days prior to bid.

E. Submittals for approval of substitute manufacturer, trade name or materials shall contain sufficient information, descriptive brochures, drawings, samples or other data as is necessary to provide direct comparison to the specified products. Each submittal shall be well marked and identified as to the type and kind of items being submitted for approval. It is the sole responsibility for the Bidder to submit complete descriptive and technical information so that the Architect can make proper appraisal. Lack of proper information will be sufficient cause for rejection. References to catalogs that the Architect may or may not have will not be accepted. Contractor shall provide a detailed schedule of proposed substitutions (as listed in 3.1 of this Section) and provide with each substitution the Substitution Request Form. Form shall be completely filled out by Contractor.

F. Interferences: Substitutions shall not be offered unless a thorough check is made of all related items and interferences, revised arrangements and other changes that may result. Prepare drawings of revised equipment and piping arrangements caused by substitutions. Such drawings shall be equal in quality to Contract Drawings. The cost of supplying drawings shall be included by the General Contractor in his estimate of proposed substituted materials.

G. Responsibility: A General Contractor offering a substitution shall accept responsibility for its effect on the work of all trades, including any possible delays in completion time of Project. All costs of changes in the work of other trades and rework or redesign required in Construction Documents, etc., affected by inclusion of General Contractor requested substitutions shall be paid by the General Contractor requesting approval of such substitution.

H. If alternate manufacturers, trade names or materials are not so approved for the Base Bid the General Contractor may, at his option, offer alternate manufacturers, trade names or materials at the time of bidding as Alternates to the Bid. This offer shall be on the General Contractor's letterhead and shall state the type of substitution in detail together with net addition to or deduction from the Base Bid.

I. Award of the Contract in accordance with Contract Documents requires that the specified manufacturers, trade names or materials and equipment shall be furnished and installed.

J. Unless specifically submitted and approved in accordance with above, substitutions will not be allowed.

3.03 MATERIAL REFERENCE STANDARDS

A. Where material is specified solely by reference to Standard Specifications, the General Contractor shall, if requested by the Architect, shall submit to the Architect, for his approval, data on all such material proposed to be incorporated into the work of the Contract listing the name and address of vendor, the manufacturer or producer, and the trade or brand names of such materials.

3.04 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

B. Submittal Form (before award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.
   2. This form is to be used during the bidding process only. No substitutions will be reviewed after contract is awarded except for special extenuating circumstances as approved by the Owner or the Architect to submit. Such circumstances do not include lead time, product availability or not being a licensed supplier of a specified brand. If you cannot provide the specified materials, do not submit a bid assuming your product will be approved instead.

3.05 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Notification of accepted substitutions will be addendum, issued by the Architect.

3.06 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

END OF SECTION 012500

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SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.

B. Progress meetings.

C. Contractor's Construction Schedule Updates.

D. Contractor's daily reports.

E. Progress photographs.

F. Submittals for review, information, and project closeout.

G. Number of copies of submittals.

H. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: General product requirements.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information; 2004.

B. CSI/CSC Form 12.1A - Submittal Transmittal; Current Edition.

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

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

C. Major Area: A separate building, or a similar significant construction element.

1.05 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. The contractor shall submit to the Owner within fourteen (14) calendar days following the contract award a graphic representation of the proposed construction schedule. This chart shall be as detailed as is practical and shall show:
   1. Project name.
   2. Contractor's name.
   3. Date of submittal.

1.06 CONTRACTOR AND NATIONAL ACCOUNT VENDOR SUBMITTALS

A. This Section includes locations in the Specification on where to find selected Contractor Submittal Requirements. This may not be a complete listing; therefore, the Contractor and National Account Vendor will need to review the entire document and provide all required data.
   1. Section 007300 - Supplementary General Conditions
      a. Paragraph 8.3.1.1; Weather delay time frames.
      b. Paragraph 9.5, 9.7, 9.8; Remedy of defective work.
      c. Paragraph 13.2.2.2; Emergency / warranty repairs time frame.
   2. Section 011000 - Summary (of Work)
      a. Paragraph 1.15; Owner’s Furnishings and Equipment Delivery Schedule.
      b. Paragraph 1.16; Building Square Footage Plan.
   3. Section 012100 - Allowances
      a. Paragraph 1.2; Notification of final selection of allowance items.
   4. Section 012500 - Substitution Procedures
   5. Section 013000 - Administrative Requirements - Construction Progress Documentation
      a. Paragraph 3.01H; Construction Progress Schedule, Reports and Charts; Submittals.
      b. Paragraph 3.02.A; Construction Schedule Updates
   6. Section 013000 - Administrative Requirements - Submittal Procedures
      a. Paragraph 1.03.B.3; Special warranties.
      b. Paragraph 3.01.C; Submit required documents, data for Owner, Architects review.
      c. Paragraph 3.13.J.12; Architects review of shop drawings.
      d. Paragraph 3.08.A; Product data submittal, number of copies required for review.
      e. Paragraph 3.08.A.3; Physical samples, number of each required for review.
      f. Paragraph 3.09; Informational submittals.

7. Section 017000 - Execution and Closeout Requirements
   a. Paragraphs 1.5 and 1.6; Submittals for Substantial Completion and final acceptance.
8. Section 017419 - Construction Waste Management and Disposal, Paragraph 1.06.D; Waste management plan.
9. Section 017800 - Closeout Submittals – Closeout Submittals
   a. Paragraphs 3.12, 3.13 and 3.14; Record as-built drawings and closeout manuals.
   b. Project Closeout Checklist

B. Time frame for Change Order and Final Payment Submittals:
1. Change Orders
   a. Provide written Change Order with all related back-up for Sprouts' review within ten (10) days of notification of a change to the construction documents caused by either a conflict in the plans or by Sprouts' directive.
2. Section 017000 - Execution and Closeout Requirements - Final Payment (3.14.A.1.a.)
   a. Provide final statement for changes to the contract sum with all related back-up for Sprouts' review thirty (30) days after store opening.
   b. Submit final statement that has been reviewed and approved by Sprouts no later than thirty (30) days after store opening.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONSTRUCTION PROGRESS SCHEDULE, REPORT, AND CHARTS

A. Within fourteen (14) calendar days of execution and delivery of the contract for construction and before the first partial payment is made, the General Contractor shall deliver to the Architect and Owner a Construction Progress Schedule in a bar chart form satisfactory to the Architect and Owner, showing the proposed dates of commencement and completion of each of the various subdivisions of the work required under the Construction Documents.

B. Submit an itemized breakdown of the costs of the various subdivisions of the work on AlA Document G702 and G703 for the purpose of evaluating the work completed for each monthly payment. Each monthly Payment Request shall be submitted in the same form with all data required by the form completed.

C. Submit all documents/data to Owner/Architect required by this Specification Manual within thirty (30) calendar days after signing contract for construction or issuance of a work order.

D. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

E. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors and National Account Vendors have reviewed and accepted proposed schedule.

F. Within 10 days after joint review, submit complete schedule.

G. Submit updated schedule with each Application for Payment.

H. Submittals:
1. Submittals Schedule: Submit an electronic file or three (3) physical copies of schedule to the Owner and Architect fourteen (14) calendar days following the contract award, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
    a. Coordinate Submittals Schedule with list of subcontracts, the National Account Vendors, the Schedule of Values, and Contractor's Construction Schedule.
    b. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
2. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
    a. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
3. 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.
    a. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
5. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
6. Arrange the following information in a tabular format:
    a. Scheduled date for first submittal.
7. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
    a. Submittal category (action or informational).
    b. Name of subcontractor.
    c. Description of the Work covered.
    d. Scheduled date for Architect's final release or approval
    e. Each major term of work.
    f. Proposed start date, duration, and completion date of each item of work.
    g. Actual start date, duration and completion date of each item of work.
    h. Application for Payment will not be processed until proposed construction schedule is submitted to the Owner
8. This chart shall be updated monthly and an electronic file or three (3) physical copies shall be submitted along with the Contractor's Application for Payment Any automated schedule system currently used and containing the above information, shall be acceptable.
9. Daily Construction Reports: Submit an electronic file or two (2) copies at weekly intervals.

10. Field Condition Reports: Submit an electronic file or two (2) copies at time of discovery of differing conditions.

I. Progress Reports: Submit monthly an updated Progress Report indicating work completed during the preceding month and indicate any revisions to the Construction Progress Schedule. Submit three (3) copies with the Request for Payment or an electronic (full color) copy can be sent to Owner and Architect for review and approval.

J. Progress Charts: Each month the General Contractor shall submit three (3) copies of a graphic progress chart. Adjust the progress chart each month to graphically exhibit the status of each phase of the work, corrected to show any differentials in starting and completion dates included in the original chart. Submit three (3) copies with the Request for Payment.

3.02 CONTRACTOR'S CONSTRUCTION SCHEDULE UPDATES

A. 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 Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect and 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.

3.03 DAILY CONSTRUCTION REPORTS

A. The contractor shall submit to the Owner at the end of each week Daily Progress Reports for each day of that week. A report shall be submitted for each day of the contract duration even if no work is performed. Copies of reports shall be maintained on the site by the Project Superintendent.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information (RFI) (to the Owner). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
1. Date.

2. Contractor's Name.
3. Project Location.
4. Describe the work in progress for the day.
5. High and low temperatures, and general weather conditions (include morning and mid-day temperatures, cloud cover, wind conditions and precipitation).
6. List of subcontractors at Project site.
7. Approximate count of personnel at Project site.
   a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
8. Major equipment at Project site.
9. Material deliveries.
10. Notification 48 hours prior to concrete pours.
11. Safety, environmental, or industrial relations incidents.
12. Meetings and significant decisions.
13. Accidents.
14. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
15. Meter readings and similar recordings.
16. Services connected and disconnected.
17. Emergency procedures.
18. Directives and requests of authority having jurisdiction (AHJ).
19. Testing and/or inspections performed.
20. Equipment or system tests and startups.
21. List of verbal instruction given by Owner and/or Architect.
22. Signature of Contractor's authorized representative.

3.04 PROGRESS PHOTOGRAPHS

A. Includes administrative and procedural requirements for the following:
   1. Preconstruction digital photographs.
   2. Construction photographs

B. Construction photographs are required in addition to all other written documentation and drawings, and in no way replace standard written documentation on this project.

C. See "Closeout Procedures" for submitting digital media via link or web portal for Project Record Documents at Project closeout.

D. Submit new photographs at least once a week, within 3 days after being taken.

E. Photography Type: Digital; electronic files.

F. Provide photographs of site and construction throughout progress of work produced by General Contractor, acceptable to Owner.

G. In addition to periodic, recurring views, take photographs of each of the following events:

1. Completion of site clearing.
2. Excavations in progress.
3. Foundations in progress and upon completion.
4. Structural framing in progress and upon completion.
5. Plumbing rough-ins.
6. Enclosure of building, upon completion.
7. Final completion.

H. Take photographs as evidence of existing project conditions as follows:
   1. Interior views: Include any existing abandoned equipment or furnishings..
   2. Exterior views: All elevations, site and parking field, and all existing roofing and drainage conditions.
   3. Preconstruction Photographs: Before commencement of excavation, demolition. construction, take color, digital photographs of Project site and surrounding properties including existing items to remain during construction, from different vantage points, as directed by Architect.
      a. Take photographs to show existing conditions adjacent to property before starting the Work.
      b. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

I. Views (of construction photographs):
   1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
   2. Consult with Owner for instructions on views required.
   3. Provide factual presentation.
   4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
   5. Key Plan: Submit for Architect and Owner's approval, a key plan of Project site and buildings with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.
   6. General: Take photographs using the maximum range of depth of field and that are in focus, to clearly show the Work. Photographs with dark, blurry, or out-of-focus areas will not be accepted, and are to be retaken as soon as possible.
   7. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
      a. Date and Time: Include date and time in filename for each image.
      b. Field Office Images: Maintain one set of images on via link or web portal, available at all times for reference. Identify images same as for those submitted to Owner.
   8. Construction Photographs: Take weekly digital photographs per the key plan and as directed by Architect or Owner.
   9. Additional Photographs: Architect may issue requests for additional photographs, in addition to construction photographs specified. Additional photographs will be provided at no cost to the Owner.

a. Circumstances that could require additional photographs include, but are not limited to, the following:
b. Special events planned at Project site.
c. Immediate follow-up when on-site events result in construction damage or losses.
d. Photographs to be taken at fabrication locations away from Project site.
e. Substantial Completion of a major phase or component of the Work.
f. Extra record photographs at time of final acceptance.
g. Owner's request for special publicity photographs

J. Digital Photographs: 24 bit color, minimum resolution of minimum of 8 megapixels, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email. Submit a complete set of digital high-resolution image electronic files as a Project Record Document via link or web portal at project closeout. Identify electronic media with date and locations that photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.
2. File Naming: Include project identification, date and time of view, and view identification.
3. Date photograph was taken if not date stamped by camera.
4. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
5. Unique sequential identifier.

K. Usage Rights: All photographs become the property of the Owner.

3.05 REQUESTS FOR INFORMATION (RFI)

A. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
b. Do not forward requests which solely require internal coordination between subcontractors.
2. Prepare in a format and with content acceptable to Owner.
a. Use AIA G716 - Request for Information, or user created form with all required, equivalent information.
3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
4. Transmit RFI's to be reviewed by Architect to:

Sprouts Team - Submittal Reviewer
Mike Wilk
Larson Design Group, Inc.
1000 Commerce Park Drive, Suite 201
Williamsport, PA 17701
LDG-SFM-CA@larsondesigngroup.com

B. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
      c. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
   4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
      a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

C. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date, and requested reply date.
   5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
   7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

D. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

E. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
   1. Indicate current status of every RFI. Update log promptly and on a regular basis.
   2. Note dates of when each request is made, and when a response is received.
   3. Highlight items requiring priority or expedited response.
   4. Highlight items for which a timely response has not been received to date.

F. Review Time: Architect will respond and return RFIs to Contractor within 3 business days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

G. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
   2. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   3. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.06 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor orNational Account Vendor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.07 SECTIONS REQUIRING SUBMITTALS

A. As a convenience to the General Contractor, and National Account Vendors, the following is a general listing of Sections requiring Action or Informational submittals as defined below in 2.2 and 2.3. ***Inclusion of a specific Section in this list does not imply applicability to the Project's scope of work, nor does this list relieve Contractors or Vendors from the responsibility to comply with submittal requirements of other Contract Documents.***
   1. Section 033000 - Cast-In-Place Concrete
   2. Section 033100 - Interior Concrete Slabs on Ground
   3. Section 042000 - Unit Masonry
   4. Section 047300 - Manufactured Stone Masonry
   5. Section 051200 - Structural Steel Framing

6. Section 052100 - Steel Joist Framing
7. Section 053100 - Steel Decking
8. Section 054000 - Cold-Formed Metal Framing
9. Section 055000 - Metal Fabrications
10. Section 064100 - Architectural Wood Casework
11. Section 074113 - Metal Roof Panels (**Florida Projects only**)
12. Section 074646 - Fiber-Cement Siding
13. Section 075400 - Thermoplastic Membrane Roofing 075400 – Thermoplastic Membrane Roofing
14. Section 081113 - Hollow Metal Doors and Frames
15. Section 081416 - Flush Wood Doors
16. Section 083613 - Sectional Doors
17. Section 083800 - Traffic Doors
18. Section 084229 - Automatic Entrances
19. Section 084313 - Aluminum-Framed Storefronts
20. Section 088000 - Glazing
21. Section 111319 - Stationary Loading Dock Equipment
22. Section 210515 – Basic Fire Suppression Piping Materials and Methods
23. Section 211100 – Fire Suppression Water Service Piping
24. Section 211313 – Water Based Fire Suppression Systems
25. Section 220515 – Basic Piping Materials and Methods
26. Section 220519 – Meters and Gauges for Plumbing Piping
27. Section 220523 – General Duty Valves for Plumbing Piping
28. Section 220550 – Vibration Isolation for Plumbing Piping and Equipment
29. Section 220700 – Plumbing Insulation
30. Section 221100 – Water Distribution Piping and Specialties
31. Section 221111 – Mechanically Joined Plumbing Piping Systems
32. Section 221112 – PEX Water Distribution Systems
33. Section 221118 – PEX Tubing and Specialties for RO and ROR Systems
34. Section 221123 – Domestic Water Pumps
35. Section 221300 – Sanitary Drainage and Vent Piping and Specialties
36. Section 221489 – Sump Pumps
37. Section 223400 – Fuel Fired Domestic Water Heaters
38. Section 224000 – Plumbing Fixtures
39. Section 227000 – Natural Gas Systems
40. Section 227010 – Mechanically Joined Natural Gas Piping Systems
41. Section 230548 – Seismic Controls for Mechanical Systems
42. Section 230593 – Testing, Adjusting and Balancing for HVAC
43. Section 230700 – HVAC Insulation
44. Section 232300 – Refrigerant Piping
45. Section 233113 – Metal Ducts
46. Section 233300 – Air Duct Accessories
47. Section 233423 – HVAC Power Ventilators
48. Section 233433 – Air Curtains
49. Section 233713 – Diffusers, Registers, and Grilles

50. Section 233723 – HVAC Gravity Ventilators
51. Section 233813 – Commercial Kitchen Hoods
52. Section 235500 – Fuel Fired Heaters
53. Section 237200 – Air-to-Air Energy Recovery Equipment
54. Section 237413 – Outdoor Packaged Heating and Cooling Units
55. Section 237433 – Dedicated Outdoor Air Units
56. Section 238126 – Split System Air Conditioners
57. Section 238500 – Electric Heating Units
58. Section 260533 – Raceway and Boxes for Electrical Systems
59. Section 260548 – Seismic Controls for Electrical Systems
60. Section 260573 – Overcurrent Protective Device Coordination Study
61. Section 260923 – Lighting Control Devices
62. Section 262200 – Low-Voltage Transformers
63. Section 262413 – Switchboards
64. Section 262416 – Panelboards
65. Section 236260 – Power Distribution Units
66. Section 262726 – Wiring Devices
67. Section 263213 – Packaged Engine-Driven Generators
68. Section 263300 – Transfer Switches
69. Section 265100 – Interior Lighting
70. Section 265600 – Exterior Area Lighting
71. Section 284600 – Fire Detection and Alarm
72. Section 311000 - Site Clearing
73. Section 312200 – Grading
74. Section 313116 – Termite Control
75. Section 315000 – Excavation Support and Protection
76. Section 321216 – Asphalt Paving
77. Section 321218 – Asphalt Seal Coat
78. Section 321726 – Tactile Warning Surfacing

3.08 SUBMITTALS FOR REVIEW (ACTION SUBMITTALS)

A. When the following are specified in individual sections, submit them for review:
   1. Product data: Collect all information into a single submittal required for each element of construction and type of product or equipment shown in a specific Specification Section.
      a. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
      b. When product data, consisting of manufacturer’s printed literature is required to be submitted to Architect, it shall be submitted in original form. Any fading type of reproduction will not be accepted. A minimum of six (6) each is required.
      c. Mark each copy of each submittal to show which products and options are applicable.
      d. Include the following information, as applicable:
         1) Manufacturer's written recommendations.
         2) Manufacturer's product specifications.
         3) Manufacturer's installation instructions.

4) Manufacturer's catalog cuts.
5) Wiring diagrams showing factory-installed wiring.
6) Printed performance curves.
7) Operational range diagrams.
8) Compliance with specified referenced standards.
9) Compliance with recognized testing agency standards.

2. 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. Include the following information, as applicable:
   a. Dimensions
   b. Identification of products
   c. Fabrication and installation drawings
   d. Roughing-in and setting diagrams
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
   f. Shopwork manufacturing instructions
   g. Templates and patterns
   h. Schedules
   i. Notation of coordination requirements.
   j. Notation of dimensions established by field measurement
   k. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
   l. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2” x 11” (215 x 280 mm) but no larger than 30” x 40” (750 x 1000 mm).
3. Samples for selection. Where indicated, submit physical samples of materials for review of kind, color, pattern, and texture of the actual component to be delivered and installed:
   a. Comply with requirements in Division 1, Section "Quality Requirements" for mockups.
   b. Transmit Samples that contain multiple, related components such as accessories, manufacturers color charts, etc., together in one submittal package.
   c. Identification: Attach label on unexposed side of Samples that includes the following:
      1) Generic description of Sample.
      2) Product name and name of manufacturer.
      3) Sample source.
      4) Number and title of appropriate Specification Section
   d. 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.

1) Number of Samples: Submit three (3) sets of Samples. Architect will retain one (1) Sample set; remainder will be returned.

e. 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.

4. Samples for verification.
5. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
6. Submittals Schedule: Comply with requirements specified in "Construction Progress Documentation".
7. Application for Payment Comply with requirements specified in Division 1.
8. Schedule of Values: Comply with requirements specified in Division 1.
9. 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.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.09 SUBMITTALS FOR INFORMATION

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit one (1) electronic copy or six (6) hard copies of each submittal, unless otherwise indicated.
2. Certificates and Certifications: Provide a notarized 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.
3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements".

B. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation".

C. When the following are specified in individual sections, submit them for information:
1. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
3. Certificates.
    a. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
    b. Installer Certificates: Prepare 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.
    c. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
    d. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
    e. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
4. Test reports.
    a. Material Test Reports: Prepare 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.
    b. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
    c. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
    d. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
5. Inspection reports.
    a. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.
6. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturers.
7. Manufacturer's field reports.
    a. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

b. Statement on condition of substrates and their acceptability for installation of product.
c. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

8. Results of operational and other tests and a statement of whether observed performance complies with requirements.
9. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.
10. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
11. Material Safety Data Sheets (MSDS): Submit information directly to Owner; do not submit to Architect. - ***Architect will not review submittals that include MSDS and will return them for resubmittal.***
12. Certification Reports: Prepare written reports for systems that are to be certified.

D. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 DEFERRED SUBMITTAL PROCESS

A. Immediately after award of the Contract, the Contractor or National Account Vendors shall contact the AHJ to coordinate and determine the AHJ requirements for deferred submittals. Information obtained shall include such requirements as number of copies; extent of detail of information to be submitted; review, if required, by Professional of Record (Architect or Engineer); and other necessary process and procedural requirements.

B. The Contractor, National Account Vendor or other entity, responsible for the submittal shall submit, track, and report submittal status to the Owner’s Construction Manager through final approval and issue of permit.

C. Communicate with vendors, suppliers, and Subcontractors the AHJ requirements for deferred submittals. Receive, review, and stamp submittals in accordance with submittal requirements herein.

D. Transmit deferred submittals directly to AHJ unless otherwise requested by AHJ to obtain prior review and approval by Professional of Record.

E. Upon approval by AHJ, obtain permits and pay permit fees and other fees required by the AHJ.

F. Attach approved deferred submittals to the approved "Permit Set" documents at the project site.

G. Do not install deferred submittals until corresponding submittal documents have been approved by the AHJ.

3.11 UNREQUESTED SUBMITTALS

A. Submittals transmitted to Architect or Architect’s consultants that are not indicated or requested will not be reviewed. Architect will dispose of unrequested submittal items.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.

D. Submit for Owner's benefit during and after project completion.

3.13 SUBMITTAL PROCEDURES

A. This Section outlines, in general, as a convenience to the General Contractor, and the National Account Vendors, submittals required before commencing construction or during the course of construction of the Project. This Section is complementary to the General Conditions and Supplementary General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions or Supplementary General Conditions.

B. See Section 016000 - Product Requirements for provisions concerning submittals of Product Data.

C. See "Construction Progress Schedule" in this Section for Submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.

D. See Section 014000 - Quality Requirements and individual specification sections for submitting test and inspection reports and for mockup requirements.

E. See Section 017800 - Closeout Submittals for submitting Warranties, Record Drawings, Record Specifications, and Record Product Data.

F. The contractor and vendors shall execute and submit to the Architect, with such promptness not to cause delay in his own work or in the work of others, shop drawings, or setting drawings, or product data, or samples, or Conformance Submittals required for the Work. The contractor and vendors shall make any corrections required and if necessary, resubmit shop drawings, or product data, or samples, or setting drawings for the Architects approval. Shop drawings, settings drawings or other action submittals required for this work are delineated in the specifications.

G. The General Contractor shall maintain a copy of the Shop Drawing Log. Each month the General Contractor shall submit copies of the Shop Drawing Log to Owner's Construction Manager for review.

H. The General Contractor and the National Account Vendor will be held responsible for any delay in progress of the work due to his failure to observe these requirements. Time for completion of the Contract for Construction will not be extended on account of his failure to promptly submit shop drawings, product data and samples.

I. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing 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.

J. General Requirements:
   1. Electronic (full color) submittals are accepted in lieu of actual physical submittals. Architect may require a physical submittal for review or approval.
      a. Any attachments and the submittal itself must be emailed to the email in section J.5.c below. The Architect will not retrieve submittals/attachments from or manage submittals on a third party database such as ProCore, PlanGrid, etc.
   2. Hard Copy Submittals: Number of Copies: Submit six (6) copies of Product Data, unless otherwise indicated. Architect will return four (4) copies minimum to the Contractor or National Account Vendor. Mark up and retain the remaining returned copies as a Project Record Document.
   3. Use a separate transmittal for each item.
   4. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   5. Transmit using approved form.
      a. Use Form CSI/CSC Form 12.1A, or user created form with all required, equivalent information.
      b. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals without review or discard submittals received from sources other than Contractor or National Account Vendor.
      c. Transmit submittals to be reviewed by Architect to:
         Sprouts Team - Submittal Reviewer
         Mike Wilk
         Larson Design Group, Inc.
         1000 Commerce Park Drive, Suite 201
         Williamsport, PA 17701
         LDG-SFM-CA@larsondesigngroup.com
   6. 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.
   7. Use for Construction: Use only final submittals with mark indicating action taken by Architect or Engineer of Record.
   8. Identification: Place a permanent label or title block on each physical submittal for identification.
      a. Indicate name of firm or entity that prepared each submittal on label or title block.

b. Provide a space approximately 4” x 5” on label or beside title block to record Contractor's or National Account Vendor's review and approval markings and action taken by Architect.
c. Include the following information on label for processing and recording action taken:
    1) Project name.
    2) Date.
    3) Name and address of Architect.
    4) Name of National Account Vendor (where applicable).
    5) Name and address of Contractor.
    6) Name and address of subcontractor.
    7) Name and address of supplier.
    8) Name of manufacturer.
    9) Submittal number or other unique identifier, including revision identifier.
    10) Number and title of appropriate Specification Section.
    11) Drawing number and detail references, as appropriate.
    12) Other necessary identification

9. Apply Contractor's or National Account Vendor's stamp (allowing room for Architect's or Engineer's stamp) signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    a. Submittals from sources other than the Contractor or National Account Vendor, or without Contractor's or National Account Vendor's stamp will not be acknowledged, reviewed, or returned.
    b. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
10. Contractor's or National Account Vendor's Review Requirements:
    a. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect or Engineer.
    b. By approving and submitting shop drawings, product data and samples, the contractor or National Account Vendor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the work and the contract documents.
    c. The contractor or National Account Vendor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect or Engineer's approval of shop drawings, product data or samples unless the contractor or National Account Vendor has specifically informed the Architect or Engineer in writing of such deviation at the time of submission and the Architect or Engineer has given written approval to the specific deviation. The contractor or National Account Vendor'sshall not be relieved from responsibility from errors or omissions in the shop drawings, product data or samples by the Architect's or Engineer's approval thereof.

d. The contractor or National Account Vendor shall direct specific attention, in writing or on resubmitted shop drawings, product data or samples, to revisions other than those requested by the Architect or Engineer on previous submittals.
e. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been approved by the Architect or Engineer. All such portions of the work shall be in accordance with approved submittals.
f. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's or National Account Vendor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
g. The General Contractor or National Account Vendor shall prepare composite drawings and installation layouts, when required to solve tight field conditions. Such drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite drawings and installation layouts shall be coordinated in the field by the General Contractor or National Account Vendor and their Subcontractors for proper relationship to the work of other trades based on field conditions and shall be checked and approved by them before submission to the Architect for his final review. The General Contractor or National Account Vendor shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the drawing and installation layouts, which have been previously determined by him to be correct and carry the Architect’s review stamp.
h. Submission of shop drawings (in either original submission or when resubmitted with corrections) constitute evidence that the General Contractor or National Account Vendor has checked all information thereon, and that he accepts and is willing to perform the work as shown in a workmanlike manner and in accordance with best standard practice. No claim for an addition to the Contract sum shall be based on work shown on shop drawings, unless such claim is noted in General Contractor’s or National Account Vendor's Transmittal Form accompanying the shop drawings.
i. Cost of any damages in construction due to improper checking and coordination by the General Contractor or National Account Vendor shall be paid for by them, and the General Contractor or National Account Vendor shall be responsible for all additional costs, including coordination.
j. Review of shop drawings and schedules shall not relieve the General Contractor or National Account Vendor from responsibility for any violation indicated on such drawings or schedules of local, county, state or federal laws, rules, ordinances or rules and regulations of commissions, boards or other authorities or utilities having jurisdiction.

11. Processing Time: Allow enough time for submittal review, including time for resubmittals (of rejected submittals or revise and resubmit submittals), as follows. Time for review shall commence on Architect's receipt of submittal.
12. Schedule submittals to expedite the Project, and coordinate submission of related items.

a. For each initial submittal for review, allow 10 business days excluding delivery time to and from the Contractor or National Account Vendor. Allow additional time if coordination with Subsequent submittals is required. Architect will advise Contractor or National Account Vendor when a submittal being processed must be delayed for coordination.
b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 5 business days.
c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 calendar days.
d. 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.

13. When revised for resubmission, identify all changes made since previous submission.
14. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
15. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
16. Submittals not requested will not be recognized or processed.

K. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. Do not submit (Material) Safety Data Sheets for materials or products.

L. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

M. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.14 SUBMITTAL REVIEW

A. General: Architect or Engineer will not review submittals that do not bear Contractor's or National Account Vendor's approval stamp and will return them without action.

B. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

1. Architect or Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect or Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
2. ***Submittals not required by the Contract Documents will not be reviewed and may be discarded.***

C. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

D. Deferred Submittals: Submittals required by the AJH for code compliance but which, rather than being submitted at the time of permit application, have been allowed by the AHJ to be deferred until after Contract award to enable the successful Contractor, Subcontractor, or Supplier to submit the applicable submittals.
1. Submit the deferred submittals to the extent indicated on the Deferred Submittal Table located on the Drawing Cover Sheet.

E. Architect's and consultant's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

F. Submittal review(s) by Architect will be general. It shall not relieve the General Contractor or National Account Vendor of responsibility for accuracy of such shop drawings, nor proper fitting, construction of work, furnishing of materials or work required by Contract Documents and not indicated on shop drawings. Shop drawing review shall not be construed as approving departures from Contract Documents.

G. Deliver no material to the building site prior to receipt of Architect’s review of submittal(s). Furnish materials equal in every respect to approved samples and execute work in conformity therewith.

H. The approval or acceptance of samples will not preclude the rejection of any material upon the discovery of defects in same prior to the final acceptance of the completed work.

I. After a material has been reviewed, no change in brand or make will be permitted unless satisfactory written evidence is presented to, and approved by, the Architect that the manufacturer cannot make scheduled delivery of required material, or that material delivered has been rejected and substitution of suitable material is an urgent necessity or that other conditions are apparent which require consideration of such substitute materials to be in best interest of Owner.

J. The right is reserved to require submission of samples of any material or any material lists whether or not specifically specified in the Specifications.

3.15 DOCUMENTS AND SAMPLES AT THE SITE

A. The contractor shall maintain, for the Architect or Owner, at the construction site one record copy of all drawings, specifications, addenda, change orders and other modifications, in good order and marked currently to record all changes during construction. This set will also include shop drawings, product data and samples. This set shall be available to the Architect, Engineer or Owner during the course of the work and shall be delivered to the Owner by the contractor upon completion of the work.

END OF SECTION 013000

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SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Control of installation.

G. Mock-ups.

H. Tolerances.

I. Manufacturers' field services.

J. Defect Assessment.

1.02 REFERENCE STANDARDS

A. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2025b.

B. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; Current Edition.

C. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

D. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.

E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025a.

F. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.03 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

C. 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.

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

E. Site Mockups: Full-size, physical assemblies that are constructed on-site, with a minimum panel size of 8’-0” x 8’-0”. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

F. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

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

H. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards and/or applicable codes.

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

J. Field Quality Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

K. Installer/Applicator/Erector.

L. Testing Agency: An entity, i.e., Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub sub-contractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

M. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

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

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

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
1. Temporary sheeting, shoring, or supports.
2. Temporary scaffolding.
3. Temporary bracing.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

C. Qualification Data: 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.

D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
1. Include:
    a. Date issued.
    b. Project title and number.
    c. Name, address, and telephone number of inspector and testing agency.
    d. Date and time of sampling or inspection.
    e. Identification of product and specifications section.
    f. Location in the Project.
    g. Type of test/inspection.
    h. Date of test/inspection.

i. Results of test/inspection.
j. Compliance with Contract Documents.
k. When requested by Architect, provide interpretation of results.
l. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
m. Name and signature of laboratory inspector.
n. Recommendations on retesting and re-inspecting.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

E. Mockups: For a typical wall panel assembly. See Section 1.5 herein.

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

G. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

1.07 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.

C. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

E. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

F. 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.

G. 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.

H. 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 products that are similar to those indicated for this Project in material, design, and extent.

I. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

J. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NISI's National Voluntary Laboratory Accreditation Program.

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

L. Site 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 full size mockups in location and of size indicated (minimum 8’-0” x 8’-0” if not indicated), or as directed by Architect.
   2. Panel shall show a typical full size wall panel assembly, consisting ·of all exterior finishing materials required for this particular project, including appropriate colors, fasteners, surface textures and showing material compatibility per Architect’s approval.
   3. Notify Architect no less than seven days in advance of dates and times when mockups will be constructed.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Owner's CPM approval of mockups before starting work, fabrication, or construction. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed by Owner unless otherwise indicated.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 32.

1.08 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 OWNER'S RESPONSIBILITIES

A. 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 inspecting they are engaged to perform.
   2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

2.03 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Notify Architectand Owner fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.

E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.04 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

2.05 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing and inspecting 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. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.

C. Owner Responsibilities: Where quality control services are indicated as Owner’s responsibility, Owner will engage a qualified Testing Agency to perform these services.

D. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   1. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor

E. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality control services.
   2. 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 inspecting 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 inspecting requested by Contractor and not required by the Contract Documents are Contractor’s responsibility.

F. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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

H. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Owner, Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.

3. Determine the location from which test samples will be taken and in which on-site tests are conducted.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Owner, Architect and Contractor of observed irregularities or non-compliance of Work or products.
6. Perform additional tests and inspections required by Owner and / or Architect.
7. Attend preconstruction meetings and progress meetings.
8. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
9. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
10. Do not perform any duties of Contractor.

I. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

J. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
    a. To provide access to Work to be tested/inspected.
    b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    c. To facilitate tests/inspections.
    d. To provide storage and curing of test samples.
4. Notify Owner and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

K. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.

5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

L. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Owner / Architect.

M. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

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

2.06 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.07 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

2.08 SPECIAL TESTS AND INSPECTION

A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying 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 re-inspecting corrected work.

2.09 TESTING LABORATORY SERVICES

A. An independent testing laboratory services will be selected by the Owner to inspect and test the materials and methods of construction for compliance with the Construction Contract.

B. The Tenant and/or Owner does not guarantee test results but agrees to use the results of these tests for determining Contract compliance.

C. When the results show that the work does not meet the full requirements of the Contract Documents, the General Contractor shall pay for retesting corrected materials or workmanship until satisfactory test results are obtained without increasing the Contract Sum.

2.10 LAB QUALIFICATIONS

A. Testing Laboratory: Shall be independent and meet the basic requirements of ASTM E329 9 - Standard of Recommended Practice for Inspections and Testing Agencies for Concrete and Steel as used in Construction, approved by the Architect, and shall submit to the Architect a copy of the report of inspection of their facilities made by the Materials Reference Laboratory of the NBS during the most recent tour of such inspections, and also shall submit a memorandum stating steps taken to remedy any deficiencies reported by this inspection.

B. Testing Machines: Shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the NBS.

2.11 AUTHORITIES AND DUTIES OF THE LABORATORY

A. The laboratory will not be authorized to revoke, alter, relax, enlarge, or release any requirement of the specifications, nor to approve or accept any portion of the work. When it appears that the material furnished, or work performed by the General Contractor fails to fulfill specification requirements, the laboratory will promptly notify all parties of such deficiencies.

B. Copies of all laboratory test and inspection reports will be issued directly to the General Contractor, the Architect, the Structural Engineer and Owner's construction manager.

C. Report test results in writing to the Architect, Engineer and the General Contractor on the same day that tests are made. Reports of compressive strength test shall contain the proper identification name and number, date of concrete placement, name of contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials. Compressive breaking strength and type of break for both 7 day tests and 28 day tests.

D. Additional Tests: The testing service will make additional test of in-place concrete when test results indicate the specific concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. The testing service shall conduct test to determine adequacy of concrete by cored cylinders and complying with ASTM C42 or by other methods as directed.

E. The Owner reserves the right to perform tests in addition to the ones mentioned herein.

2.12 STRUCTURAL CONCRETE

A. Aggregate Tests: Check the proposed aggregate in accordance with ASTM C33/C33M. (Perform only if new or suspect).

B. Mix Design: Check the proposed mixes for proportions, water-cement ration and slump in accordance with ACI 613 and 318 and with PDA T 12. (Omit if established design is used). Minimum number of tests should be one for each 5,000 cubic yards of material.

C. Slump Tests: Take at the beginning of each day's pouring operations and whenever water adjustments or noticeable change of slump occurs, ASTM C143/C143M.

D. Sampling: Make 4 standard test cylinders at the beginning of each pour and 4 additional cylinders for each additional 50 cubic yards or fraction thereof. Take extra samples at any noticeable change in the makeup of the concrete. Perform all Sampling in compliance with ASTM C172/C172M.

E. Testing: Cure cylinders in accordance with ASTM C31/C31M. Test one (1) cylinder at 7 days for compression to ASTM C39 and two (2) at 28 days and one for hold.

F. Soils testing (where not previously tested within one year or surface or subsurface change has occurred).

G. Civil staking and PAD certification.

2.13 FOUNDATIONS

A. Check excavations for correct depth into bearing strata as per boring test results.

2.14 REQUIRED SPECIAL INSTRUCTIONS

A. As required by local governmental authorities and as indicated on the Drawings.

2.15 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

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.

D. This Section outlines requirements covering testing laboratory services and inspection required during the course of construction of the Project. This Section is complementary to the General Conditions and Supplementary General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions or Supplementary General Conditions.

END OF SECTION 014000

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SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary Controls: Barriers, enclosures, and fencing.

C. Moisture and Mold Control

D. Security requirements.

E. Vehicular access and parking.

F. Waste removal facilities and services.

G. Project identification sign.

H. Field offices.

I. Operation, Termination, and Removal

1.02 SUMMARY

A. All labor, materials, equipment and services necessary to furnish, erect and maintain construction facilities and temporary controls and perform temporary work required in the performance of the Contract for Construction, including those indicated and specified. This Section is complementary to the General Conditions and Supplementary Conditions and nothing herein shall be considered to waive any requirements of the General Conditions or Supplementary Conditions.

B. The General Contractor shall verify with the Owner the storage areas allocated to the General Contractor for the work, and he shall limit his storage and office operations to the defined areas.

1.03 MAINTENANCE AND REMOVAL

A. Maintain construction facilities and temporary controls in a proper, safe operating and sanitary condition for the duration of the Contract for Construction. Upon completion of the Construction Contract work, the General Contractor shall remove all construction facilities and temporary controls from the premises.

1.04 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
   1. All utilities, temporary and permanent, shall be paid for by the General Contractor until 10 days prior to store opening or upon receipt of Certificate of Substantial Completion (or equivalent), whichever occurs first. Receipted bills setting forth that charges have been paid in full shall accompany Application for Final Payment.

B. Provide temporary adequate light and power supply for construction, making all necessary arrangements with serving utility and paying all expenses in connection therewith. Temporary lighting illumination level shall be adequate to permit workmen to properly perform their work.'
   1. Temporary electric shall be 200 Amp. Minimum.

C. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
   1. Should it become necessary to do any work in the building, such as plastering, cement work, painting, etc., at times when the temperature is below 40 deg F (painting 60 deg F), the General Contractor shall provide temporary heat (non-storage type) for such length of time as necessary for the curing and protection of the work. Pay all expenses for temporary apparatus, its installation, proper maintenance and operation and for fuel. Damage or deterioration caused by insufficient heat or ventilation shall be repaired or replaced by the General Contractor.
   2. Should temporary heat be required after permanent heating system is installed and operating, this unit may be used; however, the General Contractor shall pay all fuel costs and be responsible for proper operation of unit.

D. 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.
   1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

E. 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.

F. Provide temporary adequate water supply for construction, making all necessary arrangements with serving utility and paying all expenses in conjunction therewith.

G. Supply adequate cool, pure drinking water with individual drinking cups or sanitary bubbler fountain for the use of employees on the project. The quality of the drinking water shall meet the standards for public water supplies of the County Health Department.

H. Existing facilities may not be used.

I. New permanent facilities may be used.

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. The General Contractor shall provide and pay for installation and all local service charges involved, for the duration of the Contract for job telephone (or cell phone), internet service, computer and printer/scanner.

C. Telecommunications services shall include:
1. Internet Connections: Minimum of one; DSL modem or faster.

D. At each telephone: post a list of important telephone numbers:
1. Police and Fire Departments.
2. Ambulance service.
3. Contractor's home office.
4. Contractor's emergency after-hours telephone number.
5. Architect's office.
6. Engineers' offices.
7. Owner's office.
8. Principal subcontractors' field and home offices.

1.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization. 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.

B. Maintain daily in clean and sanitary condition.

1.07 FIRE PROTECTION

A. Access roads for fire department equipment shall be installed per requirements of authorities of jurisdiction.

B. Provide adequate fire extinguishers on the premises during the course of construction, of the type and sizes recommended by the NFPA to control fires resulting from the particular work being performed. Instruct employees in their use. Place extinguishers in the immediate vicinity of the work being performed, ready for instant use. In the use of especially hazardous type of equipment, such as acetylene torches, welding equipment, tar pots, kettles, etc., no work shall be commenced, or equipment used unless fire extinguishers of an approved type and capacity are placed in the working area and available for immediate use by the workmen using the above-mentioned equipment.

C. Fire extinguishers shall be maintained throughout all accessible areas. Provide one approved 2-1/2 gallon "foam type" extinguisher in the construction shed and also in the space where paint or oil, etc., is stored. Other special features of hazard shall be provided with special extinguisher protection as may be warranted.

1.08 BARRIERS

A. Provide and maintain all governmental required access roads and fire roads per local jurisdiction requirements.

B. Provide and maintain all fences, barricades, lights, shoring and other protective structures or devices necessary for the safety of workmen, equipment, the public and property as required by state or municipal laws and regulations, and local ordinances, laws and other requirements of the county, state, and other authorities having jurisdiction with regard to safety precautions, operation and fire hazards.

C. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

D. Provide protection for plants designated to remain. Replace damaged plants.
   1. Existing or newly planted vegetation, shrubs, trees, sidewalks, paving, etc., on the site, shall, unless directly affected by the work of this Contract, be protected against damage of any kind. No diesel or gasoline engine shall be allowed to pass over the feeder root system within the drip line unless approved by the Owner. Work, storage and traffic areas shall be restricted to those areas immediately adjacent to the building.
   2. Damage of any kind caused by the work of this contract shall be made good before final acceptance of the Project. The General Contractor shall provide water and protection barricades as required to maintain all trees, plants, shrubs, existing site improvements, etc., designated to remain.

E. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

F. Provide and maintain pumping facilities including power for keeping the site, excavations, and structure free from accumulations of water at all times, whether from underground seepage, rainfall, drainage or broken lines.

G. Maintain provisions for closing and locking the building at such time as possible to do so.

H. Protect all door openings when so required with temporary batten doors, and cover windows and openings with suitable materials when weather or job conditions require.

I. Protect all elements of construction from any danger of damage from wind, rain, dust, frost, freezing temperatures, or other infiltration of weather.

J. Protect all openings from debris (drains, pipes, etc.).

K. Provide and maintain as required all temporary access roads to and on site. Remove such roads, if not incorporated into finished construction, prior to finish surfacing or landscaping.

1.09 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.10 SCAFFOLDING, STAGING, ETC.

A. The work under each Section of these specifications shall include providing, installing, and maintaining all scaffold, staging, trestles, and planking necessary for the work under each Section in strict conformity with applicable laws and ordinances, and maintenance of same so as not to interfere with or obstruct the work of other trades. Additionally, the work under each Section of these Specifications shall include providing all forms of protection necessary to preserve the work of other trades free from damage. These provisions shall be considered as though repeated under each separate Section of these Specifications.

1.11 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.12 NOISE AND DUST CONTROL

A. Exercise all possible care to control excessive noise and dust during the construction to keep these problems to a minimum. Traffic or construction areas shall be sprinkled with water or chemicals as required and in accordance with applicable governmental requirements.

1.13 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: 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 Phase: 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, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: 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 permanent HVAC system to control humidity.
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.
   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 materials that can not be completely restored to their manufactured moisture level within 48 hours.

1.14 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft during the consruction of the Project.

B. The Architect and the Owner do not assume any responsibility, at any time, for the protection of the building and premises or for loss of materials, from the time that the Contract operations have commenced until the final acceptance of the work by the Architect and Owner. If watchman service is deemed necessary by the General Contractor, such protection shall be provided and paid for by the General Contractor.

1.15 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

E. Limit parking by construction personnel to the area designated by the Owner.

1.16 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.17 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner permission except those required by law.

1.18 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table for use by the General Contractor, Owner, and Architect.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore new permanent facilities used during construction to specified condition.

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 roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017000 - Execution and Closeout Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 015000

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product Selection Procedures

D. Product option requirements.

E. Substitution limitations.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 014000 - Quality Requirements: Product quality monitoring.

C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.

B. EN 15804 - Sustainability of Construction Works - Environmental Product Declarations - Core Rules for the Product Category of Construction Products; 2022 (Corrigendum 2021).

C. ISO 14025 - Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures; 2006.

D. ISO 14040 - Environmental Management - Life Cycle Assessment - Principles and Framework; 2006, with Amendment (2020).

E. ISO 14044 - Environmental Management - Life Cycle Assessment - Requirements and Guidelines; 2006, with Amendment (2020).

F. ISO 21930 - Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services; 2017.

1.04 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term “product’ includes the terms “material,” “equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor during bid period, reviewed by the Architect, and accepted by the Owner.

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

1.05 FACILITY AND EQUIPMENT

A. The General Contractor shall provide, install, maintain and operate a complete and adequate facility for the handling, execution, disposal and distribution of all material and equipment required for the proper and timely performance of all work connected with the Contract for Construction.

1.06 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.07 QUALITY ASSURANCE

A. All requirements and procedures covering material and equipment to be utilized in the Project work. This Section is complementary to the General Conditions and Supplementary General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions or Supplementary General Conditions.

B. See Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.

C. See Divisions 2 through 32 Sections for specific requirements for warranties on products and installations specified to be warranted.

D. CAL (CDPH SM) v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010, for the emissions testing and requirements of products and materials.

E. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.
   1. Good: Product-specific; compliant with ISO 14044.
   2. Better: Industry-wide, generic; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
   3. Best: Commercial-product-specific; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
   4. Where demonstration of impact reduction below industry average is required, submit both industry-wide and commercial-product-specific declarations; or submit at least 5 declarations for products of the same type by other manufacturers in the same industry.

1.08 WORKMANSHIP

A. Where not more specifically described in any of the various Sections of these Specifications, workmanship shall conform to all of the methods and operations of best standards and accepted practices of the trade or trades involved, and shall include all items of fabrication, construction or installation regularly furnished or required for completion (including any finish, and for successful operation as intended).

B. All work shall be executed by mechanics skilled in their respective lines of work.

C. When completed, all parts shall have been durably and substantially built and shall present a neat, workmanlike appearance.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

2.02 PRODUCT OPTIONS (COMPARABLE PRODUCTS)

A. Conditions: Architect will consider Contractor's request for comparable product when the conditions of Section 012500 - Substitution Procedures and the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   1. 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.
   2. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   3. Where products are accompanied by the term "as selected" Architect will make selection.
   4. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that comply with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, that complies with requirements.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Section 012300 "Substitutions" for consideration of an unnamed product or system (during bidding only).
8. Basis-of-Design Product: Where specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
10. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Section 012300, "Substitutions" for proposal of product.
11. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Where not more specifically described in any of the various Sections of these Specifications, workmanship shall conform to all of the methods and operations of best standards and accepted practices of the trade or trades involved, and shall include all items of fabrication, construction or installation regularly furnished or required for completion (including any finish, and for successful operation as intended).

B. All work shall be executed by mechanics skilled in their respective lines of work.

C. When completed, all parts shall have been durably and substantially built and shall present a neat, workmanlike appearance.

3.02 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.03 MATERIAL REFERENCE STANDARDS

A. Where material is specified solely by reference to Standard Specifications, the General Contractor shall, if requested by the Architect, submit to the Architect, for his approval, data on all such material proposed to be incorporated into the work of the Contract listing the name and address of vendor, the manufacturer or producer, and the trade or brand names of such materials.

3.04 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
   1. Deliver all manufactured, packaged materials in original, unopened, undamaged containers, with identification labels intact, and bearing the name of the manufacturer and brand.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
   1. Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Deliver fabrications in as large assemblies as practicable, and where specified to be shop primed or shop finished, they shall be packaged or crated as required to preserve such priming or finish intact and free from abrasion.

F. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

G. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

H. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

I. Locate storage piles, stacks, or bins to avoid or protect material from heavy and unnecessary traffic.

J. Protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture. Store materials off the ground, under cover, and in a dry location.

K. Furnish temporary protection for all exposed edges and corners.

L. Remove damaged or deteriorated materials from the premises. Damaged materials shall be replaced at the contractor’s expense (at no cost to the Owner).

M. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.05 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Store all materials in such manner as necessary to properly protect same from damage. Materials or equipment damaged by handling, weather, dirt or from any other cause will not be acceptable.

F. Store material so as to cause no obstructions, stored off sidewalks, roadways and underground services. The General Contractor shall be responsible for protecting all material and equipment furnished under the Contract. Dumping materials on the ground is not permitted.

G. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

H. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

I. For exterior storage of fabricated products, place on sloped supports above ground.

J. Provide off-site storage and protection when site does not permit on-site storage or protection.

K. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

L. Comply with manufacturer's warranty conditions, if any.

M. Do not store products directly on the ground.

N. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

O. Prevent contact with material that may cause corrosion, discoloration, or staining.

P. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

Q. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

R. When any room in the project is used as a shop or storeroom, the General Contractor shall be responsible for any repairs, patching or cleaning necessary due to such use. Location of such storage space shall be subject to approval of the Architect or Sprouts Construction Manager.

END OF SECTION 016000

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Cleaning and protection.

F. Starting of systems and equipment.

G. Semi-Final and Inspections

H. Closeout procedures, including Punch List, except payment procedures.

I. General requirements for maintenance service.

J. Construction Layout

K. Coordination of Owner installed products.

L. Protection of installed construction.

M. Project Closeout Checklist

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

B. Section 014000 - Quality Requirements: Testing and inspection procedures.

C. Section 017800 - Closeout Submittals: Project record documents, closeout manual, warranties, and bonds.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Qualification Data: For professional engineer.

C. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

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

E. Certified Surveys: Submit two copies signed by professional engineer.

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

G. Cutting and Patching:
   1. Contractor shall provide all labor, materials, equipment, and services necessary to all cutting, fitting or patching that may be required to complete the work or to make its several parts fit together properly.
   2. Submit written request in advance of cutting or alteration that affects:
      a. Structural integrity of any element of Project.
      b. Integrity of weather exposed or moisture resistant element.
      c. Visual qualities of sight exposed elements.
      d. Work of Owner or separate Contractor.
      e. Include in request:
         1) Identification of Project.
         2) Location and description of affected work.
         3) Necessity for cutting or alteration.
         4) Description of proposed work and products to be used.
         5) Effect on work of Owner or separate Contractor.
         6) Written permission of affected separate Contractor.
         7) Date and time work will be executed.
   3. Contractor shall not damage or endanger any portion of the work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work, or by excavation. The contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the written consent of the Owner and of such separate contractor. The contractor shall not unreasonably withhold from the Owner or any separate contractor his consent to cutting or otherwise altering the work.
   4. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.
   5. Quality Assurance:
      a. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
      b. 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 results in increased maintenance or decreased operational life or safety.

c. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or results in increased maintenance or decreased operational life or safety.

d. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Owner or Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   1) If possible, retain original installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

e. Warranties:
   1) Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1.05 QUALIFICATIONS

A. For surveying work, employ a professional engineer registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.

1.07 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. This section outlines requirements for cleaning of the project work. This section is complementary to the General Conditions and Supplementary Conditions and nothing herein shall be considered to waive any requirements of the General conditions or Supplementary General Conditions, or additional requirements within this specification.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.08 REQUIREMENTS OF REGULATORY AGENCIES

A. Safety and Insurance Standards: Maintain project in accordance with the following safety and insurance standards.
   1. State Industrial Commission.
   2. OSHA.
   3. Fire Protection: Store volatile waste in covered metal containers and remove from premises daily.
   4. Pollution Control: Conduct cleanup and disposal operations to comply with local ordinances and anti-pollution laws. Burning or burying of rubbish and waste material on the project site is not permitted. Disposal of volatile fluid waste (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems or in streams or waterways is not permitted.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. New Materials: As specified in product sections; match existing products and work for patching and extending work.

C. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

D. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

2.02 CLEANING MATERIALS

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 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, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, 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. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

C. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

D. Examine and verify specific conditions described in individual specification sections.

E. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

F. Verify that utility services are available, of the correct characteristics, and in the correct locations.

G. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

H. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

I. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

D. Cutting and Patching::
   1. Temporary Support: Provide temporary support of Work to be cut.
   2. Protection: Protect existing 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.

3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

G. Utilize recognized engineering survey practices.

H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.

5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
   b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

H. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

I. Clean existing systems and equipment.

J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

K. Do not begin new construction in alterations areas before demolition is complete.

L. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
1. Cut existing construction to provide for installation of other components or performance of other construction.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
1. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

F. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 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.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material , to full thickness of the penetrated element.

J. Patching:
1. General: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
3. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
4. 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.
5. Match color, texture, and appearance.
6. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
7. 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
8. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
9. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

3.07 PROGRESS CLEANING

A. During the construction period, the material to be used in the work shall be kept in an orderly manner, neatly stacked or piled.

B. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

C. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

D. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

E. Collect and remove waste materials, debris, and trash/rubbish from site daily and dispose off-site; do not burn or bury.
   1. Clean up frequently (at least daily) all refuse, rubbish, scrap materials and debris caused by operations, to the end that at all times the site of the work shall present a neat, orderly and workmanlike appearance. Sprinkle dusty debris with water.

F. Provide for the disposal of all waste products, trash, debris etc., and make necessary arrangements for legal disposal of same off the site. Never throw rubbish from windows or other parts of building. Lower waste materials in a controlled manner with as few handlings as possible.

G. Remove all surplus material, false-work, temporary structures including foundations thereof, plant of any description and debris of every nature resulting from operations and put the site in a neat, orderly condition.

H. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for acceptance.

I. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

J. General Contractor shall provide trash gondolas or containers for use by all trades.

K. General Contractor may bill trades proportionately for trash gondola use at no additional cost to the Owner or his vendors.

L. 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 materials more than 7 days during normal weather or 3 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.

M. Site: Maintain Project site free of waste materials and debris.

N. 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.

O. 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.

P. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

Q. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

R. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

S. 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.

T. 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.

U. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Use experienced workmen or professional cleaners for final cleaning.

B. Use cleaning materials that are nonhazardous.

C. Besides general broom cleaning, do following special cleaning for all trades at completion of work.
   1. Remove putty stains from glass and mirrors; wash, polish same, inside and outside. Exercise care not to scratch glass.
   2. Remove marks, stains, fingerprints, other soil, dirt from painted decorated or stained work
   3. Clean, polish and wax woodwork.
   4. Clean and polish hardware for removal of stains, dust, dirt, paint and the like.
   5. Remove spots, soil, paint from tile and similar work; wash same.
   6. Clean fixtures, equipment, remove stains, paint, dirt, dust.
   7. Remove temporary floor protections.
   8. Remove all temporary protections at the site.
   9. Remove labels which are not required as permanent labels.
   10. Clean exposed exterior and interior hard-surfaced finishes, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.
   11. Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment: remove excess lubrication and other substances.
   12. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

G. All existing improvements, inside or outside the property, which are disturbed, damaged or destroyed by the work under the Contract, shall be restored to the condition in which they originally were or to the satisfaction of the Architect.

H. Clean project site yard and grounds, including landscape development areas, of littler and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits.

I. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.

J. Pest Control: The General Contractor shall engage an experienced exterminator to make a final inspection of project, and to rid project of rodents, insects and other pests and to pay all costs for same.

K. Removal of Protection: Except as otherwise indicated or requested by Architect, remove temporary protection devices and facilities which were installed during course of the work to protect previously completed work during remainder of construction period.

L. Where extra materials of value as determined by Owner remain after completion of associated work, they shall become the property of Owner.

M. Between substantial completion and final acceptance General Contractor to maintain the store in a state of cleanliness.

3.12 SEMI-FINAL AND FINAL OBSERVATIONS

A. Closeout is hereby defined to include general requirements near end of contract time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specific throughout this specification. Time of closeout is directly related to "Substantial Completion”.

B. When General Contractor is of the opinion that the Project is Substantially Complete, he shall send to the Architect a written statement that the Project is Substantially Complete (naming a date) and shall request a semi-final site observation by the Architect to determine the status of completion. Such notice shall be given at least three (3) days before the requested site observation date.

3.13 PREREQUISITES FOR SUBSTANTIAL COMPLETION

A. Prior to requesting Architect's inspection for Certification of Substantial Completion, complete the following and list known exceptions in request.

B. In progress payment request, coincident with or first following date claimed, show either 100% completion for portion of work claimed as "Substantially Complete", or list incomplete items, value of incompletion, and reasons for being incomplete.

C. Include supporting documentation for completion as indicated in these contract documents.

D. Submit statement showing accounting of changes to the Contract Sum.

E. Advise Sprouts and Architect of pending insurance changeover requirements.

F. Submit specific warranties, workmanship/maintenance agreements, final certifications one copy for review of each required manual, and similar documents.

G. Obtain and submit releases enabling Tenant's full and unrestricted use of the work and access to services and utilities, including (where required) occupancy permits, operating certificates, and similar releases.

H. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Sprouts.

I. Make final changeover of locks and transmit keys to Authorized Sprouts Representative and advise Authorized Sprouts personnel of changeover in security provisions.

J. Complete start-up testing of systems, and instructions of Sprouts' operating/maintenance personnel. Discontinue (or change-over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-ups, and similar events.

K. Complete final clean up requirements, including touch-up painting of marred surfaces.

L. Touch-up and otherwise repair and restore marred exposed finishes.

M. If the Architect finds that the Project is Substantially Complete, he will prepare a Certificate of Substantial Completion, AlA Document G704, 2000, for the approval and acceptance of the General Contractor and the Owner, attaching thereto a list of items to be completed or corrected.

N. If the Architect does not concur in the General Contractor's claim of Substantial Completion, he will so notify the General Contractor, and thereafter the General Contractor shall initiate a new request for (semifinal) inspection. Additional site observation visits will be at the General Contractor's expense.

O. As the General Contractor completes the field report list of uncompleted or uncorrected items, he shall submit to the Architect and Sprouts for their review.

P. Record Drawings / Closeout Manuals to be submitted by General Contractor completed and initialed.

3.14 PREREQUISITES FOR FINAL ACCEPTANCE

A. Prior to requesting Architect's final site observation for certification of final acceptance and final payment, as required by General Conditions, complete the following and list known exceptions (if any) in request:
   1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
      a. Receipt/review and acceptance of all items specified in this Section and Section 017800 - Closeout Submittals is a prerequisite for final payment.
   2. Submit updated final statement, accounting for additional (final) changes to Contract Sum for Sprouts' review twenty (20) days after store turnover.
   3. Submit final statement that has been reviewed and approved by Sprouts no later than twenty (20) days after store opening.

4. Submit certified copy of Architect's/Engineer's final field report list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer. This is to be completed within 14 days of Grand Opening.
5. Submit final meter readings for utilities, measured record of stored fuel, and similar data as of time of substantial completion or when Tenant took possession of and responsibility for corresponding elements of the work (where applicable).
6. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements, as well as final warranties, guarantees, and maintenance agreements.
7. Submit completed maintenance stock sign-off sheet.
8. Final Health Department Approval (where applicable).

B. General Contractor shall call for final inspection after all construction has been completed, electric and/or gas is on, all equipment is operational, and establishment has been thoroughly cleaned. Receive Health Department approval prior to store opening, where required.

C. Send link or web portal to Owner containing a complete set of progress photographs at project closeout.

3.15 RE-OBSERVATION PROCEDURE

A. Upon receipt of General Contractor's request for final observation visit and that the work has been completed, including field report list items resulting from earlier site visits, and excepting incomplete items delayed because of acceptable circumstances, (subject to Owner and Architect approval), Architect will re-observe work.

B. If the Project is complete and all field report items are completed and corrected, the Architect will issue a final "Certificate of Payment".

C. After completion of the procedures outlined above the General Contractor shall submit his final application for payment in accordance with the Agreement, the General Conditions and Supplementary General Conditions.

D. If, because of acts or omissions of the General Contractor, the Architect is required to conduct more than one final site observation visit of the Project to review the corrections list, he will charge the Owner for the additional services required and such costs will be deducted from the money still due the General Contractor.

3.16 CLOSEOUT PROCEDURES

A. Includes administrative and procedural requirements for submittal of pertinent data relating to closing out the Project upon completion of the project work. Detailed instructions elsewhere in these Specifications may require that certain items listed herein be submitted prior to Substantial Completion of the Project.

B. This Section is complementary to the General Conditions and Supplementary General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions or Supplementary General Conditions.

C. Make submittals that are required by governing or other authorities.

D. Accompany Architect on preliminary observation to determine items to be listed for completion or correction in the Correction Punch List for Notice of Substantial Completion.

E. Notify Architect when work is considered ready for Architect's Substantial Completion site observation visit.

F. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Owner's Substantial Completion inspection.

G. Conduct Substantial Completion inspection and create Final Correction Punch List containing Contractor's comprehensive list of items identified to be completed or corrected and submit to Owner.

H. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

I. Complete items of work determined by Owner listed in executed Certificate of Substantial Completion.

3.17 FINAL CHECKOUT OF STRUCTURE AND EQUIPMENT WITH OWNER

A. Arrange for each installer of work requiring continuing maintenance or operation, to meet with Owner personnel, at the project site, to provide basic instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts, and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrate start-up, shutdown, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, energy effectiveness, and similar operations. Review maintenance and operations in relations with applicable warranties, agreements to maintain, bonds, and similar continuing commitments.

3.18 PROJECT CLOSEOUT CHECKLIST

I/We, the undersigned, propose to do all the work necessary for the construction of subject project as set forth in the Drawings and Project Manual (bid documents):

Sprouts Farmers Market – **Store #0680, 3111 Mahan Drive, #18, Tallahassee, FL 32308**

As prepared by: Larson Design Group, Inc., 495 N Keller Road, Suite 101, Maitland, FL 32751

Separate Electronic Files – Each to Contain:	**Not Completed**	**Not Approved**	**Completed**	**Remarks**
Table of Contents				
Certificate of Occupancy				
Recorded Notice of Completion (where required by the State / AHJ)				
Certificate of Substantial Completion: Signed Copy				
General Contractor Certificate of Insurance				
General Contractor Warranty				
Punchlist: Copy of Owner Signed List				
List of Subcontractors: Including Phone Numbers				
Lien Waivers from Subcontractors: Verified with Owner				
Camera footage of sanitary and grease waste piping and grease interceptor				
Warranty Section:				
033000 Cast in Place Concrete – 2 years				
033100 Cast-In-Place Concrete Slabs on Ground – 2 years				
042000 CMU - 2 years				
047300 Manufactured Stone Masonry - 2 years				
054000 Cold-Formed Metal Framing - 2 years				
071400 Cold-Fluid Applied Waterproofing – 2 years				
072100 Thermal Insulation - 2 years				
074113 Metal Roof Panels - 20 years				
074646 Fiber-Cement Siding - 30 years				

075400	Thermoplastic Membrane Roofing System - 20 Years NDL				
076200	Sheet Metal Flashing - 2 years				
077200	Roof Hatch - 1 year				
079200	Joint Sealants - 5 years				
081113	Hollow Metal Doors and Frames				
081416	Flush Wood Doors - 2 years				
083100	Access Doors - 2 years				
083613	Sectional Doors - 2 years				
084229	Automatic Entrances				
084313	Aluminum Framed Storefront				
088000	Glazing - 10 years				
093000	Tiling - 2 years				
095100	Acoustical Ceilings - 2 years				
096723	Resinous Flooring - 2 years				
097200	Fiber Reinforced Panels - 2 years				
099000	Painting and Coating - 2 years				
102113.13	Metal Toilet Compartments -2 years				
102600	McCue Rails and Bollards - 2 years				
102800	Toilet Accessories				
111319	Loading Dock Equipment - 5 years on mechanics, 10 years on structure				
123600	Solid Surface Countertops (restrooms) - 10 years				
220010	Plumbing				
221123	Water Pumps (if applicable)				
223400	Water Heater - 3 years on tank, 1 year on controls				
230010	HVAC - 1 years plus 5 years Compressor Warranty				
233433	Air Curtains - 5 years				
260010	Electrical				
262600	Power Distribution System – 3 years				
265100	Lighting - 1 year LED Lighting - 5 yearsLED Lamps - 3 yearsLighting battery backup - 10 yearsExit Signs - 7 years				
265600	Exterior Lights - 1 year				
284600	Fire Alarm				
	Fire Protection				

313116	Soil Poisoning / Termite Treatment - 5 years				
321216	Asphalt Paving				
323113	Fencing - 5 years				
	Landscaping – 1 year plants & irrigation				
Drawings of Record:					
As-Builts: Electronic Digital Data (PDF/TIFF)					
	Cover Sheet signed and dated by the General Contractor				
	All Field Changes Incorporated				
	All Revisions, Addendums, and CCD's incorporated				
	Specifications				
	Sewer Invert Elevations Indicated				

DATE: _____

CONTRACTOR: _____

BY: _____

TITLE: _____

END OF SECTION 017000

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Salvaging non-hazardous demolition and construction waste.
   2. Recycling non-hazardous demolition and construction waste.
   3. Disposing of non-hazardous demolition and construction waste.

1.02 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.

E. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

F. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

G. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.03 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures.

B. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

D. Section 016000 - Product Requirements: Waste prevention requirements related to product substitutions.

E. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

F. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

G. Section 311000 - Site Clearing: For disposition of waste resulting from site clearing and removal of above-and below-grade improvements.

1.04 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

D. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill acceptable to authorities having jurisdiction.

E. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

F. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

G. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

H. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

I. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

J. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

K. Return: To give back reusable items or unused products to vendors for credit.

L. Reuse: To reuse a construction waste material in some manner on the project site.

M. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

N. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

O. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

P. Toxic: Poisonous to humans either immediately or after a long period of exposure.

Q. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

R. Waste (Construction): Building and site improvement materials and other extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.05 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following.
   1. Construction Waste:
      a. Masonry and CMU.
      b. Lumber.
      c. Wood sheet materials.
      d. Wood trim.
      e. Metals.
      f. Roofing.
      g. Insulation.
      h. Carpet and pad.
      i. Gypsum board.
      j. Piping.
      k. Electrical conduit.
      l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      m. Paper.
         1) Cardboard.
         2) Boxes.
         3) Plastic sheet and film.
         4) Polystyrene packaging.
         5) Wood crates.
         6) Plastic pails.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the Notice to Proceed to Owner's CPM.

C. Submit Waste Management Plan within 10 calendar days after receipt of Notice to Proceed, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.

D. Waste Management Plan: Include the following information:
   1. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
   2. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   3. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work on a form acceptable to Owner for construction waste. Include estimated quantities and assumptions for estimates.
   4. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   5. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the local market for each material.
      c. State the estimated net cost, versus landfill disposal.
   6. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   7. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   8. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
   9. Recycling Incentives: Describe procedures required to obtain credits, rebates, or similar incentives.

E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.

b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

4. Incinerator Disposal: Include the following information:
   a. Identification of material.
   b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
   c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards.
   c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them.

G. Landfill Disposal Records: Indicate receipt and acceptance of waste by landfills facilities licensed to accept them.

1.07 QUALITY ASSURANCE

A. Waste Management Conference: Conduct conference at Project site.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. See Section 016000 and Section 012500.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 016000:
   1. Relative amount of waste produced, compared to specified product.
   2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Price.
   3. Proposed disposal method for waste product.
   4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. General: Implement approved waste management plan as approved by the Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

C. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

D. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

E. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Preconstruction meeting.
   2. Regular job-site meetings.

F. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.

2. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.
3. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
4. Locate enclosures out of the way of construction traffic.
5. Provide adequate space for pick-up and delivery and convenience to subcontractors.
6. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
7. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

G. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

H. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

I. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

J. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

K. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

3.03 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill 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. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them. Contractor shall keep at least one (1) dumpster on site for a period of 2 weeks following turnover.

END OF SECTION 017419

SECTION 017610
TEMPORARY PROTECTIVE COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary protective coverings for installed floors, walls, other surfaces, and equipment / fixtures.

1.02 RELATED REQUIREMENTS

A. Section 017000 - Execution and Closeout Requirements: Coordination of requirements for materials specified in this section.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:
   1. Water resistant.
   2. Vapor permeable.
   3. Impact resistant.
   4. Flame retardant.

PART 3 EXECUTION

3.01 Preparation

A. Remove dirt and debris from surfaces to be protected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and comply with requirements for temperature and humidity.

B. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

C. Trim or overlap sheet materials to fit area to be covered.

D. Roll out and cut rolled materials to fit area to be covered.

E. Tape seams. Avoid taping directly to finished surfaces.

3.03 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
   2. Restore permanent facilities used during construction to their specified condition.

B. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

C. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

D. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

3.04 REMOVAL

A. Remove protective coverings prior to Date of Substantial Completion. Reuse or recycle materials if possible.

END OF SECTION 017610

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Closeout Manual.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Warranties and Bonds:
   1. General:
      a. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
      b. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
      c. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.
   2. 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.
      a. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

b. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

3. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   a. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   b. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
   c. Refer to Divisions 2 through 32 Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. General Contractor shall provide Record Drawings (at his cost) as-built plans reproduced from the construction set which shall clearly show all differences between the Contract for Construction as drawn and all as installed work, as well as work added to the Contract for Construction which is not shown on the Drawings.

B. General Contractor shall maintain a set of Record Drawings at the job site and shall, within twenty (20) days after substantial completion of the project, provide the Architect with record drawings for review. These shall be kept legible and current and shall be available for inspection at all times by the Architect. Show all changes in the Contract work, or work added, on these Record Drawings in a contrasting color, including work changed by Addendum or PR.

C. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda, ASI and PR's.
   4. Field Changes.
   5. Change Orders and other modifications to the Contract.

D. In showing changes in the work, or added work, use the same legends as were used on the Drawings. Indicate exact locations by dimensions and exact elevations given in job datum, by depth. Give dimensions from a permanent point. Give elevations to sewer and storm drainage lines to the invert elevation.

E. Mechanical and Electrical Record Drawings shall indicate exact routing of all piping, duct work, power and control wiring, etc., location and function of all controls and whether manual or automatic and normal amperage readings for all motors taken at the equipment under normal load conditions.

F. Ensure entries are complete and accurate, enabling future reference by Owner.

G. Store record documents separate from documents used for construction.

H. Record information concurrent with construction progress.

I. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

J. Record Drawings: Legibly mark each item to record actual construction including:
   1. Record Drawings shall contain the names, addresses and phone number of the Subcontractors and shall be signed by the General Contractor on the front cover.
   2. Field changes of dimension and detail.
   3. Details not on original Contract drawings.

K. Architect shall review the Record Drawings and he shall be the sole judge of the acceptability of these drawings.

3.02 CLOSEOUT MANUAL

A. Upon completion of the Project, the General Contractor shall submit to the Architect via weblink or web portal the complete closeout manual for review and approval. The General Contractor shall upon receipt of notice of review and approval of the Record Closeout Manual from the Architect, provide web link or web portal access (with record drawings), of the closeout manual to the Architect and Owner.

B. **Items in the closeout manual package shall be sorted into the folders specified below by the General Contractor prior to submittal to the Architect. If the closeout submittal is found to be incomplete by six items or less, the Architect will complete the missing items into the folders. If more than six items are missing, the General Contractor shall resubmit the entire manual for review.**

C. The closeout manual shall each include all information in accordance with the following outline:
   1. TABLE OF CONTENTS: Neatly typed, in orderly sequence, provide the following information:
      a. LIST OF SUBCONTRACTORS / SUPPLIERS
         1) Provide the Trade, Name, Address, Phone #, and Contact person for each subcontractor and/or supplier for the project.
      b. PUNCHLIST: Copy of Owner's signed list.
      c. CERTIFICATE OF OCCUPANCY: Document issued by local governmental authority certifying that the building complies with the provisions of applicable statutes and regulations and permitting occupancy for the designated use.
      d. RECORDED NOTICE OF COMPLETION: Document issued by local government authority certifying that the building is complete and all regulation and permitting requirements have been accepted. This form is to be provided to Owner prior to grand opening.

e. CERTIFICATE OF SUBSTANTIAL COMPLETION: signed by Owner, General Contractor, and Architect.

f. GENERAL CONTRACTOR WARRANTY: The General Contractor shall warranty all work to the Owner for a period of one (1) year. Warranty period begins on the earlier of: (1.) Grand Opening Date or (2.) 45 days after the documented Substantial Completion unless specified for a longer period. In the case of work performed by a Subcontractor, the General Contractor shall warranty the work to and in favor of the Owner.
   1) General Contractor shall submit written guarantee to the Owner stating that all work has been performed in accordance with the drawings and specifications (and authorized change orders, if any). General Contractor shall also guarantee all work against defects due to faulty workmanship or materials and shall agree that during the guarantee period he shall make all repairs necessitated by reason of faulty workmanship or materials promptly and at no cost to the Owner.

g. GENERAL CONTRACTOR CERTIFICATE OF INSURANCE.

h. SUBCONTRACTOR/SUPPLIER WARRANTIES
   1) In addition, each subcontractor shall warranty their work for a period of 1 year unless otherwise noted and repair work that proves to be defective in workmanship and/or materials due to above work without expense whatsoever to the Owner. Warranty period begins on the earlier of: (1.) Grand Opening date or (2.) 45 days after the documented Substantial Completion date. Included, but are not necessarily limited to the following.
   2) Provide warranties for all subcontractors/manufacturers as indicated in Section 00030.

i. MAINTENANCE MATERIAL LIST (Spare Parts)
   1) See Paragraph 1.10 herein.

j. SYSTEMS SECTIONS:
   1) FIRE SPRINKLER SYSTEMS SECTION -Equipment list including the following items for every piece of material and equipment supplied by the fire sprinkler systems subcontractor.
      a) Subcontractor Name, Address, Phone #; After Hours Phone # and contact.
      b) Name, model and manufacturer.
      c) Complete parts drawings and list.
      d) Local supply for parts or replacement with addresses and telephone numbers.
      e) Local service organizations for equipment with address and 24 hour telephone numbers.
      f) All tags, inspection slips, etc., removed from equipment as shipped from the factory.
      g) All approved shop drawings and/or submittals.
      h) Maintenance instructions with schedule of frequency of lubrication, cleaning, adjusting, replacing etc.
      i) Prior to store turnover, Sprinkler Contractor shall provide an Obstruction Investigation Review and Report for Sprouts as part of their Closeout Procedures.

2. MECHANICAL SYSTEMS SECTION: Equipment list including the following items for every piece of material and equipment supplied by the Mechanical Subcontractor.
    a. Subcontractor Name, Address, Phone #, After Hours Phone # and contact.
    b. Name, model and manufacturer.
    c. Complete parts drawings and list.
    d. Local supply for parts or replacement with addresses and telephone numbers.
    e. Local service organizations for equipment with address and 24 hour telephone numbers.
    f. All approved shop drawings and/or submittals.
    g. Maintenance instructions with schedule of frequency of lubrication, cleaning, adjusting, replacing, etc.
    h. Motor compressor warranty.
    i. EMS closeout documents.
3. PLUMBING SYSTEMS SECTION: Equipment including the following items for every piece of material and equipment supplied by the Plumbing Systems Subcontractor.
    a. Subcontractor Name, Address, Phone #, After Hours Phone # and contact.
    b. Name, model and manufacturer.
    c. Complete parts drawings and list.
    d. Local supply for parts or replacement with addresses and telephone numbers.
    e. Local service organizations for equipment with address and 24 hour telephone numbers.
    f. All approved shop drawings and/or submittals.
    g. Maintenance instructions with schedule of frequency of lubrication, cleaning, adjusting, replacing, etc.
4. ELECTRICAL SYSTEMS SECTION: Equipment list including the following items for every piece of material and equipment supplied by the Electrical Systems Subcontractor.
    a. Subcontractor Name, Address, Phone #, After Hours Phone # and contact.
    b. Name, model and manufacturer.
    c. Complete parts drawings and list.
    d. Local supply for parts or replacement with addresses and telephone numbers.
    e. Local service organizations for equipment with address and 24 hour telephone numbers.
    f. All approved shop drawings and/or submittals.
    g. Maintenance instructions with schedule of frequency of lubrication, cleaning, adjusting, replacing, etc.

D. Submittal requirements.
1. Assemble warranties, bonds, service and maintenance contracts, executed by each of the respective manufacturers, suppliers and subcontractors.
2. Number of original signed copies required: three (3) each. Information shall include:
    a. General Contractor, name of responsible principal, address and telephone number.

3.03 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION 017800

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.
   1. Procedures for demolition and removal of existing building elements.
   2. Protection of existing construction.
   3. Salvaged material and items.
   4. Schedule of building demolition.
   5. Disposal of demolished materials (non-hazardous and hazardous).
   6. Site improvements including site utilities.

1.02 RELATED REQUIREMENTS

A. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

B. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

C. Section 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

D. Section 311000 - Site Clearing: Vegetation and existing debris removal; earth stripping and stockpiling.

1.03 DEFINITIONS

A. Demolish: Dismantle, raze, destroy, or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. 40 CFR 82 - Protection of Stratospheric Ozone; Current Edition.

C. ANSI A10.6 - Safety & Health for Demolition Operations; Current Edition.

D. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 SYSTEM DESCRIPTION

A. Selective Demolition Requirements:
1. Perform demolition in construction sequence phases according to Construction Sequence Drawings.
2. Work necessary and required to facilitate the new construction indicated.
3. Demolish so that construction, new and existing, can be performed and completed in accordance with construction documents.
4. Visit the project site and become familiar with the existing conditions and project requirements.
5. Clarify the scope of the Work under this Section including salvage material. The Owner will be responsible for removing materials and equipment which the Owner wishes to salvage prior to the beginning of this Work.
6. Retain existing fire protection sprinkler system in place and active.
7. Contractor is responsible for damage to existing structure and replacement or repair of damage.
8. Repair, replace, or rebuild existing construction as required or as directed which has been removed, altered, or disrupted to allow for new construction. Correct existing construction to match adjacent construction, new or existing as specified in Section 017000 - Execution and Closeout Requirements (Cutting and Patching).

B. Regulatory Requirements:
1. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, runoff control, and disposal.
2. Obtain required permits from authorities having jurisdiction and submit to Owner.
3. Notify affected utility companies before starting work and comply with their requirements. Submit Certificates for severance of utility services and submit confirmation documentation of all utility company contacts to Owner.
4. Do not close or obstruct roadways, sidewalks, or hydrants without permits from authorities having jurisdiction and Owner’s Construction Manager.
5. Conform to applicable regulatory procedures when discovering hazardous, contaminated, and universal waste materials.
6. Test soils around buried tanks for contamination (where buried tanks occur).

1.06 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during building demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.07 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Qualification data for the following:
   1. Demolition contractor.
   2. Professional engineer.
   3. Refrigerant recovery technician.

C. Proposed Protection and Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate. Include measures for the following:
   1. Environmental protection.
   2. Dust control.
   3. Noise control.

D. Schedule of Building Demolition/Repair Activities: Indicate detailed sequence of demolition, removal and repair work, with starting and ending dates for each activity, interruption of utility services, and locations of temporary protection and means of egress.
   1. Contractor shall submit a proposal describing procedures at least ten (10) working days prior to the time cutting and patching is to be performed, requesting approval to proceed, including but not limited to.
   2. Cutting and patching description, showing how they will be performed, and indicating why they are needed.
   3. Results: modifications to structural and operational components, change of building appearance, and other functional items.
   4. List products to be utilized and companies that will perform the work.
   5. Identify when cutting and patching will be performed.
   6. Identify which utilities cutting and patching procedures will be affected by relocation or will be temporarily out of service (for how long).
   7. Where reinforcement is required to be added to support structural elements, provide details and engineering calculations relative to original structure.
   8. Obtain approval of cutting and patching prior to commencement of work. Approval does not waive right to later require removal and replacement of unsatisfactory work.

E. Pre-demolition Digital Photographs (time and date stamped on image): Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by building demolition operations. Submit before Work begins.

F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

G. 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 according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

H. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.08 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of five years of documented experience.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

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

D. Standards: Comply with all local codes and standards including but not limited to OSHA, ANSI A10.6 and NFPA 241.

E. Pre-demolition Conference: Conduct conference at Project site.

F. Performance Criteria:
   1. Requirements of Structural Work: Do not cut structural work in a manner resulting in a reduction of load-carrying capacity of load/deflection ratio.
   2. Operational and Safety Limitations: Do not cut operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in a manner intended or resulting in a decreased operational life, increased maintenance, or decreased safety.
   3. Visual Requirements: Do not cut work which is exposed on the exterior or exposed in occupied spaces of the building in a manner resulting in a reduction of visual qualities or resulting in substantial evidence of the demolition work judged by the Architect to be cut and patched in a visually unsatisfactory manner.
   4. Loading: Do not superimpose loads at any point upon existing structure beyond design capacity including loads attributable to materials, construction equipment, demolition operations, and shoring and bracing.
   5. Vibration: Do not use means, methods, techniques, or procedures which would induce vibration into any element of the structure.
   6. Fire: Do not use means, methods, techniques, or procedures which would produce any fire hazard.
   7. Water: Do not use means, methods, techniques, or procedures which would produce water run-off, and water pollution.

8. Air Pollution: Do not use means, methods, techniques, or procedures which would produce uncontrolled dust, fumes, or other damaging air pollution.

G. Patch components in a manner that provides a watertight/weathertight condition.

H. Employ skilled workers to perform cutting and patching.

I. Existing Warranties: Using methods and materials compatible with existing construction, remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, so as not to void existing warranties.

PART 2 PRODUCTS

2.01 SOILS MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 311000 - Site Clearing.

PART 3 EXECUTION

3.01 DEMOLITION

A. General: Demolish indicated existing buildings, structures, 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 fire watch and 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. Engineering Surveys: Perform surveys as the Work progresses to detect hazards that may result from building demolition activities.

C. 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 traffic ways 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.

D. Reference Schedule of Demolition at end of this Section.

E. Remove other items indicated, for salvage, relocation, and recycling.

3.02 EXAMINATION

3.03 Survey existing conditions and correlate with requirements indicated to determine extent of building demolition required.

A. Review Project Record Documents of existing construction provided by Architect. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

B. Inventory and record the condition of items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to Architect.

D. Demolition contractor to have engineering consultants on retainer for review of special conditions.
1. OSHA regulations require that a "competent person" perform an engineering survey before building demolition begins.
2. Engage a professional engineer to 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.

E. Retain below if hazardous material remediation is part of the Work of this Contract.
1. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.04 PREPARATION

A. Ensure safe passage of persons around area of demolition.

B. Protect existing finish work to remain in place.

C. Protect floors with suitable coverage.

D. Refrigerant: Remove and store refrigerant according to 40 CFR 82 and regulations of authorities having jurisdiction.

E. 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.

F. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

G. Cease operations and notify Owner’s Construction Manager immediately if safety or structure appears to be endangered.
   1. Take precautions to support structure until determination is made for continuing operations.

3.05 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Section 017000.

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

C. Arrange demolition schedule so as not to interfere with Building Owner's, Adjacent Tenants, or on-site operations.

D. Owner will occupy another building immediately adjacent to demolition area. Conduct building demolition so Owner's operations will not be disrupted.
   1. Provide not less than 72 hours notice to Construction Manager of activities that will affect operations.
   2. Maintain access to existing walkways, exits, and other adjacent occupied or used facilities.

E. Owner assumes no responsibility for buildings and structures to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

F. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Use of explosives is not permitted.
   3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   7. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   8. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

G. Do not begin removal until receipt of notification to proceed from Owner.

H. Do not begin removal until built elements to be salvaged or relocated have been removed.

I. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.

J. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

K. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
   2. Hazardous materials will be removed by Owner before start of the Work.
   3. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

L. Mold and Mildew: The following requirements shall apply to all new and remodel construction projects.
   1. In the event the contractor discovers, at any time during demolition, construction and/or remodeling operations, existing conditions that could include the presence of mold and/or mildew, the contractor shall immediately notify the tenant's representative and the professional of record, in writing, of the concerns and/or suspicions.
   2. Concurrently, the contractor shall be responsible to retain a mold and mildew certified testing agency to perform an investigation and testing as required to evaluate the nature and extent of the problem. if the testing agency confirms hazards, the contractor shall be responsible to obtain a minimum of two (2) bids from companies qualified and licensed to perform all necessary remediation work, complying with all local, state and federal environmental regulations, codes, and statutes.
   3. Once discovery or suspicion of mold and/or mildew is made, the contractor shall take all responsible measures and practice precautions to protect all construction personnel and the public from exposure to mold and/or mildew, and such precautions shall remain in place until such a time as the owner or health authority directs otherwise. construction operations shall not be stopped or curtailed, except in the area of mold/mildew concern, due to these required precautions.
   4. The contractor shall make all reasonable efforts to avoid conditions favorable to the development of mold and mildew, especially in voids which will be concealed and not ventilated. in all cases, interior spaces and interior finished construction shall be maintained in dry and well-ventilated conditions.
   5. The contractor shall comply with federal environmental and osha regulations and all local and state health department requirements and recommendations regarding mold and mildew.
   6. All penetrations shall be sealed water-tight to prevent moisture migration from entering the building or wall cavities.
   7. Ensure that there are no water leaks in concealed plumbing chases. all existing supply air paths and all existing return air paths and plenums shall be kept dry.
   8. Ductwork to be re-used shall be cleaned and treated as required to remove potential for mold and mildew. all damp areas shall be dried thoroughly prior to enclosure.

M. Storage or sale of removed items or materials on-site is not permitted.

3.06 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction and approval by Owner's Construction Manager.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.

I. Provide by-pass connections as necessary to maintain continuity of service to occupied areas of building.

J. Provide advance notice to Owner if shut-down of service is necessary during change-over.

3.07 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.
1. Provide temporary shoring, bracing and supports for building structure as required for support of structure during demolition of existing structural elements and to prevent movement, settlement of existing building and adjacent buildings and facilities to remain.
2. Prevent movement of structure. Provide shoring and bracing as required.
3. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
4. Repair adjacent construction and finishes damaged during removal work.
5. Patch to match new work.

3.08 MECHANICAL DEMOLITION

A. Remove buildings, structures, and site improvements intact when permitted by authorities having jurisdiction.

B. 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 next lower level.

C. Remove debris from elevated portions 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 or dust generation.

D. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.

E. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.

F. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.

G. Structural Steel: Dismantle field connections without bending or damaging steel members. Do not use flame-cutting torches unless otherwise authorized by Architect or authorities having jurisdiction.
1. Transport steel trusses and joists as whole units without dismantling them further.

H. Carpet and Pad: Remove in large pieces and roll tightly after removing demolition debris, trash, adhesive, and tack strips.

I. Building Components: Remove the following components, as whole units, intact and undamaged:
   1. Metal gratings.
   2. Metal ladders.
   3. Doors.
   4. Windows.
   5. Door hardware.
   6. Cabinets.
   7. Mirrors.
   8. Chalkboards and marker boards.
   9. Tack boards.
   10. Toilet accessories.
   11. Plumbing fixtures.
   12. Light fixtures.

J. Elevators: Remove as whole units as much as practical.

K. Equipment: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.

L. Below-Grade Construction:
   1. Abandon foundation walls and other below-grade construction as indicated on construction drawings or as directed by Architect. Cut below-grade construction minimum 12” below finish grade / floor slabs.
   2. Demolish existing concrete slabs, foundation walls, grade beams and other below-grade construction as referenced in the geotechnical report or as indicated on construction drawings or as directed by Architect.
   3. If existing foundations are discovered during construction activities that are not shown on the Construction Drawings, for clarification of Demolition or Abandonment, the contractor shall notify Architect and Owner, survey the locations, and note them on the as built plans as a record of the locations.
   4. If drilled footings are present, the shafts are to be broken off at an elevation about 24 inches below the bottom of proposed new foundations. If portions of drilled footings are left in place the General Contractor is to survey the locations and note them on the as built plans as a record of the locations.
   5. Backfill with properly placed and compacted select fill as indicated in the Appendix A - Geotechnical Report.

M. Existing Utilities:
   1. Abandon and remove existing utilities and below-grade utility structures. Cut utilities (cap and plug) minimum 12” below finish grade and floor slabs. Service lines that are not being reused are to be cut and capped to a point not farther than 5’-0” outside the building footprint.
   2. Contractor shall notify Architect and Owner regarding existing utilities discovered during construction activities that are not shown on the Construction Drawings for clarification of Demolition or Abandonment.
   3. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31 Section "Earthwork”.

N. Demolish and remove existing utilities and below-grade utility structures.

3.09 EXPLOSIVE DEMOLITION

A. Explosives: Use of explosives is not permitted.

3.10 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 311000 - Site Clearing.

C. 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.

3.11 REPAIRS

A. General: Promptly repair damage to adjacent construction caused by building demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.12 CUTTING AND PATCHING

A. Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the work or to make components fit together properly. Cut existing construction to provide for installation of components or to perform other construction, and patch as required matching surfaces to their original condition.

B. Contractor shall not damage any portion of the work by cutting, patching or modifying any work, or by excavation.
   1. Contractor shall not cut or make alterations to the work without the written consent of the Construction Manager/Architect.
   2. Contractor shall not withhold from the Construction Manager/Architect or any separate contractor his consent to cutting or otherwise altering the work.

C. Prior to commencing work, examine surfaces to be cut and patched, and conditions under which cutting and patching are to be performed.
   1. Prior to patching, verify compatibility of existing finishes or primers.
   2. Proceed with work after unsafe or unacceptable conditions have been corrected.

D. Provide temporary support of Work to be cut. Protect existing construction during cutting and patching to prevent damage. Provide protection of work from adverse weather conditions that might be exposed during cutting and patching operations.

E. Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 2 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.

F. Proceed with patching after construction operations requiring cutting are complete.

G. Patch construction by filling, repairing, refinishing, closing up, and similar operations following other work. Patch with durable seams that are as invisible as possible.
   1. Where applicable, test and inspect patched areas after completion to demonstrate integrity of installation.
   2. 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.
   3. Where walls or partitions are removed extend one finished area into another, patch and repair floor and wall surfaces in the new area. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   4. Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance

3.13 ENVIRONMENTAL CONROLS

A. Use water sprinkling, temporary enclosures, and other proper control methods to maintain airborne dust and dirt below permissible levels.

B. Comply with governing regulations pertaining to environmental protection.

C. Do not use water when it may create hazardous or objectionable conditions, such as ice, flooding, or pollution.

D. For work scheduled in this section including cutting and breaking of masonry, concrete slab below or on grade, walls, foundation work, or footings, use tools equipped with integrated water delivery systems that continuously feed water to the blade or a HEPA-rated filter dust collection vacuum system recommended by the manufacturer to maintain dust emissions below the permissible level.

3.14 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and reinstalled in their original locations after demolition operations are complete.

C. Existing Utilities: Maintain utility services indicated to remain and protect them 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 to authorities having jurisdiction.
      a. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.

D. 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 Division 1 Section "Construction Facilities and Temporary Controls."
   1. Protect existing site improvements, appurtenances, and landscaping to remain.
   2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   3. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   4. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

3.15 RECYCING DEMOLISHED MATERIALS

A. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type.
   1. Provide containers or other storage method approved by Architect for controlling recyclable materials until they are removed from Project site.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from the weather.

5. Transport recyclable materials off Owner's property and legally dispose of them.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling building demolition materials shall accrue to Owner.

3.16 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Burning: Do not burn demolished materials.
2. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

3.17 POLLUTION CONTROLS

A. Use temporary enclosures and other proper control methods to maintain airborne dust and dirt below permissible levels.

B. Comply with governing authorities pertaining to environmental protection.

C. Clean adjacent portion of the structure and improvement of dust, dirt and debris caused by demolition operations, as directed by the Owner’s Construction Manager and governing authorities. Return adjacent areas to conditions existing prior to the start of the work.

D. Burning of trash, debris, or removed materials not permitted on site.

3.18 SCHEDULE OF SELECTIVE DEMOLITION

A. Remove and dispose of existing building items and adjacent sitework items as required for Work and as indicated on Drawings.

B. Sitework Adjacent to Building:
1. Fencing, gates and concrete post footings.
2. Asphalt or concrete paving.
3. Metal handrails and railings.

C. Interior or Exterior Slab on Grade:
1. Locate portion of existing concrete slab to be removed. Saw cut perimeter of existing slab minimum of 50% of slab thickness to provide a breaking point to remove existing concrete.

2. Wet saw concrete slabs along straight lines to a minimum depth of 2 inches where concrete is to be removed. The method of removal shall maintain the undamaged slab edge within the sawed line. Jack hammers may be used only “after hours” and with permission from the Owner’s Construction Manager. Jack hammers may not be used to remove/cut concrete from the existing slab, but only to break up concrete which has already been saw cut from the concrete slab.
    a. Jack hammers shall be equipped with field assembled water delivery systems that supply a continuous stream or spray of water at the point of impact or HEPA-rated filter dust collection vacuum system recommended by the manufacturer to maintain dust emissions below the permissible level.
3. Break concrete slab to be removed into portions easily removed, maximum 3 feet dimension at any side.
4. Remove concrete pieces within removed area down to the existing subgrade.

D. Exterior Masonry:
1. Locate portion of existing masonry wall to be removed. Units which are removed: "tooth" from existing construction.
2. Verify that temporary supports, enclosures, and bracing are in place and adequate for intended purpose.
3. Remove only that portion of the exterior wall which is required for the indicated new construction.

E. Below Grade Construction:
1. Remove below grade construction including foundation work, column footings, and abandon mechanical, plumbing, and electrical work as indicated.

F. Interior Walls and Partitions:
1. Remove interior walls and partitions as indicated.
2. Remove all top and bottom framing tracks and overhead braces of partitions being removed.

G. Doors and Frames:
1. Remove hollow metal doors and frames.
2. Remove aluminum storefront doors and frames.
3. Remove aluminum automatic doors and frames.

H. Interior Finishes:
1. Remove carpet and carpet adhesives.
2. Vinyl composition tile flooring (VCT)
3. Acoustical ceiling tile (ACT)
4. Polyvinyl Chloride (PVC) plank flooring.

I. Mechanical System:
1. Remove mechanical equipment and related ductwork as indicated.
2. Provide temporary weathertight protection of openings in roof and exterior walls.
3. Remove accessories to the mechanical system including, but not limited to, hanger straps.

J. Plumbing:

1. Remove plumbing fixtures and accessories including exposed supply, waste, and vent piping as indicated.
2. Identify concealed piping within and below slab construction and cap a minimum of 3 inches below finish floor unless otherwise noted.
3. Cap or plug ends of below grade abandoned sewer and drain pipe and vents. Abandoned branch drains connected to a live line shall be capped within two feet of connection to the live line.

K. Electrical Service:
1. Remove abandoned electrical fixtures, conduit, boxes, and wiring as indicated.
2. Remove electrical circuits including conduct as indicated.

3.19 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations.

B. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024100

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SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies cast-in-place concrete and related items, including formwork, steel reinforcement, concrete materials, mixture design, joints, templates, anchors, cutting and patching, placement procedures, sealants, and finishes.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver and install concrete work as indicated on the drawings, in accordance with local codes and standards, or as specified herein. This work includes but is not limited to all exterior slabs, footings, retaining walls, beams, forming, shoring, bracing, welding, bending, form removal, finishing, cleaning, and related work. All interior concrete slabs on ground work is specified in section 033100 – Cast-In-Place Interior Concrete Slabs on Ground.

C. Coordinate delivery with other work to avoid delay.

D. All work shall be coordinated with other Sections including but not limited to:
1. Section 055000, "Metal Fabrications".
2. Section 129300, “Site Furnishings”.
3. Section 129313, "Bike Racks".
4. Section 033100, "Cast In Place Interior Concrete Slabs on Ground".
5. Section 079200, “Joint Protection”.
6. Appendix A – Soils Report.

1.02 REFERENCE STANDARDS

A. ACI 310.1 - Specification for Polished Concrete Slab Finishes; 2020.

B. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

C. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

D. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

E. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

F. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.

G. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.

H. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

I. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

J. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

K. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

M. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

N. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.

O. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).

P. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

Q. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

R. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

S. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

T. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.

U. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

V. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

W. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2025a.

X. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2023.

Y. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; 2023.

Z. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

AA. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).

BB. AWS A5.10/A5.10M - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods; 2023.

CC. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).

DD. CRSI (DA4) - Manual of Standard Practice; 2024.

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Sections 013000 and 016000.

B. Product Data: For each type of manufactured material and product indicated.
   1. Within 20 calendar days after the General Contractor has received the Notice to Proceed, the following shall be submitted:
      a. Materials list of items proposed to be provided under this section.
      b. Manufacturers' specifications, test data, and all other data required to show compliance with the specification and drawing requirements.
      c. Manufacturers' printed recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejection actual installation procedures used in the work.
   2. Submit special concrete finishes describing products and level of finish to be provided. Include stain, dye, and MSDS for project. Submittals for Work of this Section shall be separate from submittal for Interior Concrete Slabs specified in Section 033100.

C. Design Mixtures:
   1. Submit mix design for each class of concrete to the Architect for review. Mix design submittal shall include aggregate gradation reports. Sieve analysis sampling and testing for each aggregate shall be conducted within 60 days of concrete submittal. Provide compressive strength test data per ACI 318 requirements.
   2. Review of mix design by the Architect will in no way relieve the Contractor of his responsibility for the performance of the concrete.

D. Shop Drawings for steel reinforcement and formwork:
   1. Shop drawings shall show all bending and assembly diagrams, bent bar diagrams, bar schedules, stirrup spacings, splicing, laps, dimensions, shapes, details, sections, elevations, and accessories.
   2. Contract drawings shall not be reproduced for use as shop drawings.
   3. Include all special reinforcement required, and openings through concrete structures.
   4. Prior to fabrication, contractor shall submit certified mill test reports for each grade of steel to be used, for review by the Architect.
   5. Contractor shall submit five copies of manufacturers' specifications and installation instructions for all proprietary materials and reinforcement accessories.

E. Furnish copies of all material test reports and certificates to the Architect.

F. Furnish copies of all compaction test reports and certificates to Sprouts Farmers Market and the Architect prior to installation of concrete. Reports shall be submitted in a timely manner to allow Sprouts Farmers Market and the Architect a minimum of 5 working days for review prior to concrete installation.

G. Welding certificates.

H. Substitutions shall be requested in accordance with Sectionsn 012300, and 016000 of this Specification.

I. Refer to Division 1 for payment provisions for testing.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in measuring, mixing, and delivery of ready-mixed concrete products.
   1. The firm must comply with ASTM C94/C94M requirements for production facilities and equipment; except that time in mixer after water has been added at batch plant is limited to 1-1/2 hours.
   2. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

B. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design and extent to that indicated for this project on a minimum of three (3) separate projects, and whose work has resulted in construction with a record of successful in-service performance.
   1. Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts, and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this section. Flatwork finishers shall be ACI certified or equal.

C. Contractor shall comply with the codes and standards including but not limited to:
   1. ACI SPEC-301, "Specification for Structural Concrete", Sections 1 through 5, and Section 7, "Lightweight Concrete".
   2. ACI SPEC-117, "Specifications for Tolerances for Concrete Construction and Materials".
   3. ACI PRC-304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
   4. ACI 310.1 "Guide to Decorative Concrete".
   5. ACI CODE-318, "Building Code Requirements for Structural Concrete".
   6. AWS D1.4/D1.4M, "Structural Welding Code-Reinforcing Steel".
   7. Concrete Reinforcing Steel Institute, "Manual of Standard Practice" and "Placing Reinforcing Bars".

D. Sprouts will employ a Concrete Quality Control Agent to monitor and report the quality of the concrete work, including but not limited to: review of concrete delivery tickets/receipts, concrete arrival, mixing and placement times, slump tests, test sampling, temperatures, site conditions, and concreting operations. This agent will have authority to reject defective concrete material(s) and work. All costs for rejected materials and work shall be borne by the Contractor.

E. Job-mixed concrete shall be subject to Architect's review of design, mixing and handling procedures.

F. Fly ash testing: Concrete test submittals must be reviewed and approved prior to the installation of any concrete, and should not indicate the presence of fly ash, unless aggregate contains high alkaloid content.
   1. Obtain samples in accordance with ASTM C172/C172M. Mold and cure specimens shall be in accordance with ASTM C31.

2. Test specimens in accordance with ASTM C39/C39M. Report all test results to the Architect where deviations from Specifications occur on the same day as the tests are made.

G. The design, engineering and construction of the formwork shall be the responsibility of the Contractor.
1. Shoring and reshoring for slabs, beams and walls shall be designed by a registered Structural Engineer.
2. Design the formwork in accordance with the loads and lateral pressures outlined in ACI PRC-347, Part 3, paragraph 1.2.
3. Design formwork for wind loads as required by local codes, and as indicated on the drawings.
4. Protect all materials before, during, and after installation, and protect work and materials of all other trades. In the event of damage, immediately make replacements and repair to the approval of the Architect, and at no additional cost to the Owner.
5. Concrete sealer manufacturer shall certify acceptability of applicator of sealer products and required grinding and polishing. Provide letter of Certification from concrete finish manufacturer stating that the installer is a certified applicator of special concrete finishes and is familiar with proper procedures and installation requirements required by the manufacturer.

H. Warranty:
1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
2. Warranty Period: two (2) years commencing on Date of Certificate of Occupancy.
3. Additional requirements for product warranties are included in Section 016000.

1.05 DELIVERY, STORAGE AND HANDLING

A. Transport and handle all materials in such a manner as to prevent damage. Dumping on the ground is not permitted.

B. Locate storage piles, stacks, or bins to avoid or protect material from heavy and unnecessary traffic.

C. Furnish temporary protection for all exposed corners and edges.

D. Deliver all packaged materials in original, unopened, undamaged containers, with identification labels intact, and bearing the name of the manufacturer and brand.

E. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

F. Store and protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer.
1. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture.

2. Store moisture-sensitive materials off the ground, under cover, and in a dry location.
3. Additional requirements for product delivery, storage and handling are in Section 016000.

1.06 PROJECT CONDITIONS

A. Cold Weather Requirements: Comply with Cold Weather Concreting requirements contained in ACI PRC-306.

B. Hot Weather Requirements: Comply with hot-weather concreting requirements contained in ACI PRC-305 and as follows: Maintain concrete temperature 90 deg F at time of placement. Chilled mixing or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

C. Comply with concrete sealant manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.

PART 2 – PRODUCTS

2.01 GENERAL FORMWORK

A. The design, engineering and construction of the formwork shall be the responsibility of the Contractor.
1. Shoring and re-shoring for slabs, beams and walls shall be designed by a registered Structural Engineer.
2. Design the formwork in accordance with the loads and lateral pressures outlined in ACI PRC-347.
3. Design formwork for wind loads as required by local codes, and as indicated on the drawings.
4. Protect all materials before, during, and after installation, and protect work and materials of all other trades. In the event of damage, immediately make replacements and repair to the approval of the Architect, and at no additional cost to the Owner.

B. Contractor shall provide forms for all concrete, except that which is authorized to be placed directly against earth in trenches.

C. Contractor shall provide positive means of adjustment of formwork and shoring to prevent excessive deflection or misalignment during concrete placement.

D. General formwork (concealed concrete) shall be constructed of plywood or approved patented formwork systems with plywood facings with as large a face dimension as possible.

E. Exposed concrete formwork shall be constructed of medium density overlaid form panel.

F. Formwork accessories shall be Burke Concrete Accessories, Inc.
1. Snap ties shall be Burke Architectural Snap Ties. Spreader cones on ties shall not exceed 1" in diameter.

2. Form coating requirements shall be determined by the form system being used. Form coating shall be compatible with the finishes used on concrete surfaces.

2.02 STEEL REINFORCEMENT

A. Contractor shall furnish and install all labor, materials, equipment and services as required herein to provide a complete concrete reinforcing system including but not limited to bars, wire fabric, ties, and supports.
   1. Work in this section also includes furnishing and installation of all vertical reinforcing steel in masonry walls, and all bond beam steel.

B. All reinforcement shall be delivered to the project site bundled, tagged, and marked to facilitate sorting and placing.
   1. Tags shall indicate bar sizes, lengths, grade, and other information corresponding to markings shown on placement diagrams.
   2. Transport and store reinforcement at the site off the ground and in a manner to prevent damage to the materials.

C. Reinforcing Bars shall be provided as follows:
   1. ASTM A615/A615M, Grade 60 (Grade 420), deformed.
   2. ASTM A615/A615M, Grade 40 as noted on the drawings only.
   3. ASTM A706/A706M weldable rebar.
   4. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M , epoxy coated, with less than 2% damaged coating in each 12” (300-mm) bar length.

D. Concrete reinforcement fabrication tolerances shall be as follows:
   1. Sheared length: Plus 1”, Minus 1”.
   2. All other bends: Plus 1”, Minus 1”.

E. Concrete reinforcement placing tolerances shall be as follows:
   1. Depth D, in flexural members, walls and columns where D is 24” or less: 1/4” ±.
   2. Depth D, in flexural members, walls and columns where D is more than 24”: 1/2" ±.
   3. Longitudinal location of bends and ends of bars: 2” ±, except that specified concrete cover at ends of members shall not be reduced.

F. Welded wire reinforcement:
   1. Plain-steel welded wire reinforcement, ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.
   2. Deformed-steel welded wire reinforcement: ASTM A497, flat sheet.
   3. Epoxy-coated welded wire reinforcement: ASTM A884/A884M, Class A coated, type 1.

G. All reinforcing steel shall be of new billet stock, deformed carbon steel bars.

H. Tie wire shall be annealed steel wire not lighter than 16-gauge, complying with ASTM A82.

I. Welded wire fabric shall be electrically welded wire fabric of cold-drawn wire (70,000 psi yield point) of gauge and mesh indicated, conforming to ASTM A 185. Material shall have carbon content between 0.10% and 0.30% and be welded with low hydrogen rods only.

J. Welding rods shall be of E-70 series low hydrogen conforming to AWS A5.10/A5.10M.

K. Provide supports for reinforcement including bolsters, chairs, spacers, and other devices suitable for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place.
1. Use wire bar-type supports complying with PS 7. Wood, brick, and other materials are not acceptable for this application.
2. Manufacture bar supports according to CRSI (DA4) "Manual of Standard Practice".
3. Metal chairs shall be galvanized, or plastic tipped for all exposed concrete. If fiberboard forms are used, provide chairs with runners to avoid joist loading or puncture.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain admixtures from single source from single manufacturer throughout Project:
1. Portland Cement: ASTM C150/C150M, Type II, alkali content not to exceed 0.6%. Use only one brand of approved cement throughout the project unless use of more than one approved brand is acceptable to Architect.
a. Fly Ash: (If permitted to be used) ASTM C618, Class F. Fly ash replacement, if permitted, shall be limited to 10% by volume.

B. Aggregates: Obtain aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregate and cementitious material:
1. Coarse Aggregate shall meet the requirements of ASTM C33/C33M, Table II, size 57.
2. Normal weight Aggregates shall meet the requirements of ASTM C33/C33M, not exceeding 1".
3. Fine Aggregate shall meet the requirements of ASTM C33/C33M.

C. Water: potable complying with ASTM C94/C94M.

D. Air-Entraining Admixture shall comply with ASTM C260/C260M 0.

E. Use of Chemical Admixtures is allowed only with prior approval from Architect. As allowed, provide admixtures certified by manufacturer to contain not more than 0.1% water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Mid-Range, Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Non-slip Admixture shall be Frictex NS as manufactured by Sonneborn Chemical Corporation.

2.04 CURING MATERIALS

A. Clear, water-based curing compound may be used as approved by the Architect.
   1. Seal Tight 1100 – Clear by W.R Meadows, Inc. or approved equal.

2.05 RELATED MATERIALS

A. Concrete accessories shall be as manufactured by Gateway Engineering Co., Superior Concrete Accessory Company, or Burke Concrete Accessories.

B. Leveling compound shall be as recommended by Ardex to be used in areas of floor covering only.

C. Non-shrink grout shall be Embeco premixed as manufactured by Master Builders Company, Burke Grouting Compound, 5 Star Grout. Grout shall have 28-day compressive strength of not less than 7500 psi conforming to ASTM C827/C827M.

D. Expansion- and Isolation-Joint-Filler Strips shall be as required by ASTM D1752, type I or II preformed, non-extruded, resilient type. ASTM D1751, asphalt-saturated cellulosic fiber.

E. Floor crack filler shall be non-metallic, non-shrink, waterproof filler having a minimum compressive strength of 4000 psi.

F. Handicap accessibility ramp color shall be as indicated on drawings or required by local jurisdiction.

2.06 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned based on laboratory trial mixture or field test data, or both, according to ACI SPEC-301.

B. Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: As indicated on the drawings or structural calculations.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: 4”, plus or minus 1”.
   4. Air Content: 3% maximum point of delivery. (19-mm)
   5. No air entrainment allowed for interior power troweled floors.

2.07 CONCRETE MIXING

A. Design concrete mixes in accordance with ACI PRC-211.1 to obtain a 28-day comprehensive strength as scheduled for the various building elements.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork according to ACI SPEC-301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Remove all debris and foreign material from the forms, and repair or replace damaged areas, prior to assembly.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI SPEC-117.
   1. Formwork shall be constructed in a substantial manner, true to line and sufficiently tight to prevent leakage of cement paste.
   2. Coat and contact surfaces of forms with a form coating compound before reinforcement is placed. Thin form-coating compound only as recommended by the form-coating manufacturer. Prevent excess accumulation of form coating or contact with concrete surfaces against which fresh concrete will be placed. Apply coating in compliance with manufacturer's instructions.
   3. Construct shoring and centering to prevent perceptible deflection. Brace and double wedge on bearing blocks and mudsills to distribute the construction loads evenly and safely. Keep wedges tight during concrete placement and until shoring is removed.
   4. Do not construct formwork more than 1'-0" above a construction joint at the side from which the concrete will be placed.
   5. Wet the wood forms and masonry units in contact with concrete.
   6. No wood other than built-in-bucks or nailing blocks will be permitted to remain permanently inside the forms.
   7. Provide block-outs in concrete as indicated on the drawings or as required for mechanical, plumbing, electrical or other work.
   8. Provide slab slopes and concrete drainage trenches as indicated on the Drawings. Slopes on slabs and in trenches shall be uniform and pitched to drain.

D. Provide temporary openings at the base of forms and all other points to facilitate cleaning and inspection before the concrete is placed. After forms have been cleaned and inspected, close openings to prevent leakage of grout.

E. See Architectural drawings for chamfers and reveals. Where none is shown, provide 1/2" vinyl bead in all exposed angles to form a slightly rounded corner.

F. Form removal shall be performed in a manner to ensure the complete safety and integrity of the structure. Supports or forms should not be disturbed until the concrete has hardened and acquired sufficient strength to safely sustain its own weight and any additional load occurring during construction.
   1. Form removal shall conform to the following minimum time schedule:
      a. Wall forms: Not less than three (3) days after placing the concrete.
   2. Refer to Section 3.9 herein for curing procedures when forms are removed in less than seven (7) days.

3.02 EMBEDDED ITEMS

A. Contractor shall coordinate the necessary trades as required to provide the sleeves, bolts, anchors, holes, etc., to be built in.

B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install all bucks, nailing blocks, inserts, and anchors, in the precise position required.
   2. Form all grooves, seats, reglets, etc., as required to receive the material and equipment indicated.

3.03 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" and ACI CODE-318 for placing reinforcing steel.
   1. Place the steel in accordance with the drawings and schedules, and secure in position to prevent displacement during placing of concrete. In earth trenches, provide concrete block supports; on formwork, provide approved metal or plastic chair and spacer supports. Secure with ties against displacement within the tolerances specified herein.
   2. Adjust bar placement as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. Such adjustment is subject to approval of the Architect.
   3. Lap splices shall be as specified on the drawings and schedules. Splices shall be subject to the approval of the Architect.
   4. Bars shall be continuous insofar as practicable. Dowels shall be of sufficient length to develop the strength of the bar. Secure dowels in the forms prior to placing the concrete.
   5. Use flat sheets of wire mesh reinforcing and cut to the required size and lay reasonably flat in place. In slabs-on-grade and in non-composite concrete topping, lap 2” minimum between outer most cross wires on each sheet. Elsewhere, lap one wire spacing plus 2” minimum between outer most cross wires on each sheet. Wire securely to each other and to the adjoining reinforcement. Chair mesh in place to its proper depth in concrete.
   6. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Fabricate and place steel reinforcing in accordance with requirements of ACI SPEC-117.

C. Shop fabricated reinforcing bars shall conform to the required shapes and dimensions, with fabrication tolerances complying with ACI SPEC-117. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.

D. Bend bars cold and shop fabricate insofar as practicable. Bends for stirrups and ties shall have radii on the inside of the bar not less than one bar diameter. Bends for all other bars shall have radii on the inside of the bar not less than the values listed below:

Bar Size	Minimum Radii
#3, #4 or #5	2-1/2 Bar Diameters
#6, #7 or #8	3 Bar Diameters
#9, #10 or #11	4 Bar Diameters

E. Reinforcement shall be free of excessive mill scale, excessive rust, oil or other deleterious material harmful to bonding qualities.

F. Reinforcement with any of the following defects will not be permitted in the work:
   1. Bar lengths, depths, and bends exceeding the specified fabrication tolerances.
   2. Bends or kinks not indicated on the Drawings or final Shop Drawings.
   3. Bars with reduced cross section due to excessive rusting or other cause.

G. Welding of reinforcing steel shall comply with the requirements of AWS D1.4/D1.4M, Structural Welding Codes- Reinforcing Steel for field welding.

H. Prior to field welding, determine the weldability of the reinforcing bars by a laboratory chemical analysis of the steel. Only steel conforming to the chemical requirements specified in AWS D1.4/D1.4M may be welded.

3.04 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Submit proposed locations of all construction joints and control joints and obtain Architects approval prior to construction. If additional reinforcing is required at some of these joints, labor and materials to install additional reinforcing shall be provided by contractor at no additional cost to the Owner.

C. All reinforcing shall be continuous through construction joints and control joints. Provide shear keys as detailed on the drawings.

D. At all exterior slabs-on-grade, provide a 1/2” wide expansion joint wherever slabs abut vertical elements whether indicated on the drawings or not. Provide expansive heavy traffic grade waterproof sealant at all exterior joints.

E. Construction Joints/Control joints:
   1. Place constructions joints and control joints as indicated on the drawings and as specified herein.
   2. See Drawings for locations of construction joints and control joints in slabs-on-grade and in topping pours.
   3. Install all joints so strength and appearance of concrete are not impaired, at locations indicated, or as approved by Architect.

3.05 CONCRETE PLACEMENT

A. Contractor shall comply with the recommendations of ACI PRC-304 for measuring, mixing, transporting, and placing concrete, except as follows:
   1. Cold-Weather Placement: Comply with the requirements of ACI PRC-306, Cold Weather Concreting.
   2. Hot-Weather Placement: Comply with the requirements of ACI PRC-305, Hot Weather Concreting.

B. Before placing concrete, clean all the equipment involved. Remove all concrete laitance, loose materials, rust, mill scale, and other material which may reduce bonding with the reinforcing steel.

C. Before placing concrete, verify that installation of all formwork, reinforcement, and embedded items are complete, and that required inspections have been performed.

D. Convey the concrete from the mixer to the place of final deposit by methods which will prevent segregation of aggregate or loss of material.
   1. Place concrete at such a rate that the concrete is at all times plastic, and to insure a practically continuous flow of concrete.
   2. Concrete not in place 1-1/2 hours after the water has been added at batch plant will not be accepted.
   3. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness.
   4. If a section cannot be placed continuously, provide construction joints as required.

E. Place the concrete as nearly as practicable in its final position to avoid segregation due to re-handling or flowing. Do not deposit concrete that has partially hardened or been re-tempered.

F. Thoroughly compact all concrete by suitable means during the placing, and work around the reinforcement and embedded items to allow proper placement of concrete into the corners of the forms.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI SPEC-301.
   2. Use vibrators to aid in the placement of the concrete, operated by experienced personnel.
   3. Design forms to withstand the action of the vibrators.
   4. Keep at least one spare operating vibrator on the job at all times during the concrete operations.

G. Do not place concrete during rain unless adequate protection has been provided.

H. FINISHING FORMED SURFACES (Walls, Beams, Soffits, Columns, etc.)

I. After forms are removed, fill tie rod holes, correct honeycomb spots, remove fins, and clean and finish damaged surfaces. Wipe off excess mortar and rub to match adjoining surfaces.

J. When excessive honeycombing is revealed, remove the defective material immediately after stripping forms to a depth of 3/4” to 1”. Cut edge of area perpendicular to surface to avoid weathered edges. Saturate with water for several inches beyond cutout, and brush-in a grout consisting of equal parts Portland cement and sand. Follow immediately with the patching mortar. Leave the patch slightly higher than the surrounding surface. After an hour or two, finish flush with the adjoining surface. Wipe and rub patch to match adjoining surfaces. Keep patches moist for 7 days.

K. Patching mortar shall consist of the same materials and proportions as the original concrete, except that the coarse aggregate shall be omitted. When color match is required, adjust mixture to produce a finished color to match the adjoining concrete surfaces.

L. Cracks caused by expansion, shrinkage, and the like, that occur in natural color concrete up through final acceptance of building, shall be carefully patched with floor stone, epoxy grouting mortar, or other method acceptable to the Architect.

M. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

N. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.06 CONCRETE PROTECTING AND CURING

A. Curing of all concrete surfaces shall be as follows:
1. Apply specified curing materials to fresh concrete surfaces after final troweling, when surface water glaze has disappeared.
2. Application is to be in strict compliance with manufacturers' recommendations, specifically manufacturers' precautions and coverage rates.
3. Protect all finished concrete surfaces from damage caused by construction equipment, materials, or methods.
4. During the curing period, protect the concrete from damaging mechanical disturbance, particularly load stresses, heavy shock, and excessive vibrations.
5. Adjust finish schedules when rain and other inclement weather may affect the drying of site concrete.
6. When moisture sensitive floor coverings are to be installed, refer to ACI PRC-302.1.

B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with applicable ACI requirements for hot and cold weather protection during curing.

C. Protect all finished surfaces from stains, abrasions, etching, discoloration, gouging, scratches, and marring. Protect surfaces and edges by leaving forms in place, by providing temporary covers, diapers, plastic, etc., to avoid marring gouging, etc. Protect all concrete from rain, flowing water, or mechanical injury.

D. If evaporation rate in first paragraph below is exceeded, ACI PRC-305 states that plastic shrinkage cracking is probable. See manufacturers' literature or ACI PRC-305 for estimated moisture-loss chart relating relative humidity, air and concrete temperature, and wind velocity to rate of evaporation.

E. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturers' written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

F. Cure concrete according to ACI PRC-308, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) 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" (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Apply clear, water-based curing compound in accordance with manufacturer's written instructions.

G. After curing, allow sufficient time for drying.

3.07 CONCRETE SEALING

A. Apply minimum of 2 coats of specified sealer/hardener to point of rejection.

B. Concrete must be cured a minimum of 21 days or as directed by the manufacturer before application of sealer/hardener can begin. Application is to take place at least 10 days prior to racking and other in-store accessory installation, thus providing a complete, uninhibited concrete slab for application.
   1. Only a certified applicator shall apply sealer/hardener. Applicable procedures must be followed as recommended by the product manufacturer.
   2. Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the color and sheen.

3.08 CONCRETE SURFACE REPAIRS

A. All floors which are not within the tolerances specified in the contract documents shall be corrected by one of the following methods:
   1. Removal and replacement of the defective slab is the only allowed solution at areas of exposed concrete. Removal shall be from score to score.
   2. Limited grinding of the surface of the concrete to bring it into compliance with specified tolerances. This is allowed at concrete slab areas only with Architect approval.

3. Refer to Section 017310, Cutting and Patching for cutting and patching, and other work requirements.

3.09 FIELD QUALITY CONTROL

A. Testing and Inspecting: Concrete tests and inspections shall be made by an approved independent testing laboratory at the direction of the Architect. Approximately one test shall be made for each 50 cubic yards of each class of concrete when placed in large continuous pours. At least one test shall be made of pours less than 50 cubic yards.
   1. Testing Services: Tests shall be performed according to ACI SPEC-301.
   2. Tests shall be made for 7 day and 28 day strength. Mold 4 (5) cylinders for each test; 1 for 7-day test, 2 (3 if 4” x 8” cylinders are used) for 28-day test and 1 for hold.
   3. Furnish copies of all test reports to the Architect.

END OF SECTION 033000

SECTION 033100
INTERIOR CONCRETE SLABS ON GROUND

PART 1 - GENERAL

1.01 SUMMARY

A. Interior concrete slabs on ground.

1.02 RELATED REQUIREMENTS

A. Section 012500 – Substitution Procedures.

B. Section 013000 – Administrative Requirements (for Submittal Procedures).

C. Section 014000 – Quality Requirements.

D. Section 016000 – Product Requirements.

E. Section 033000 – Cast-in-Place Concrete.

F. Section 033543 – Polished Concrete Finish and Joint Filler.

G. Section 079200 – Joint Sealants.

1.03 REFERENCE STANDARDS

A. American Concrete Institute
   1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials
   2. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
   3. ACI 301 - Specifications for Structural Concrete for Buildings
   4. ACI 305.1 - Hot Weather Concreting
   5. ACI 306.1 - Cold Weather Concreting; American Concrete Institute International.
   6. ACI 308.1 - Guide to Curing Concrete
   7. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
   8. ACI 347 - Guide to Formwork for Concrete

B. ASTM International
   1. A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   2. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   3. C33/C33M - Standard Specification for Concrete Aggregates.
   4. C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete.

5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
6. C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. C150/C150M - Standard Specification for Portland Cement.
8. C171 - Standard Specification for Sheet Materials for Curing Concrete.
9. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
12. C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
13. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
14. C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
15. C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
16. C779/C779M - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
17. E1155 - Determining Floor Flatness and Levelness Using the F-Number System
18. E 1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
19. E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Concrete Consultant
1. Sprouts Farmers Market (Sprouts) has contracted Structural Services, Inc. (SSI) to provide consultation to Sprouts, AoR, and EoR as defined in Section 033100. SSI can be reached at 214-522-6438 or sprouts@ssiteam.com.
2. Any recommendations or changes discussed with SSI must be approved in writing through RFI submission before implementation. SSI does not have direct authority to change any requirements of the contract documents or to approve any portion of the work.

B. Pre-installation Meeting
1. Plan, host, and attend a concrete pre-slab meeting that SSI will conduct at the job site.
2. Schedule the meeting 7 and 14 days before the first concrete slab placement and after all 033100 submittals have been approved. SSI will provide an agenda upon scheduling.
3. Responsible representatives of each party involved with the interior concrete slab work must attend the meeting. Representatives to be present shall include personnel directly involved in managing, planning and overseeing the work for each placement and who have the authority to supervise the concrete installation work, including, but not limited to:
   a. Owner / Developer
   b. Sprouts Project Manager

c. SSI
d. Construction Testing Laboratory (Individual present during and managing all slab placements.)
e. General Contractor:
    1) Project manager
    2) Superintendent
f. Concrete Finishing Subcontractor:
    1) Project manager
    2) Finish Foreman1
g. Concrete supplier:
    1) Quality Assurance Representative (Individual present during and managing all slab placements.)
h. Polishing / Joint Filling Subcontractor (via phone)
i. Electrician
j. Plumber
k. Refrigeration Contractor

C. Before implementation, changes to the contract documents must be approved in writing by Sprouts or AoR based on recommendations or discussions at the Pre-installation meeting. No other party is authorized to allow changes to any specified requirement or to approve the execution of any portion of the work.

1.05 SUBMITTALS

A. See Section 013300 – Submittal Procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
1. Submit one document that contains the following product data found in this Section only:
    a. Vapor Retarder
    b. Isolation Material
    c. Exportation Retarder
    d. Wet Cure Cover (polished slabs)
    e. Curing Agent (non-polished slabs)
    f. Plate Dowels

C. Aggregate Base Coarse material.

D. Shop Drawings: Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

E. Slab Joint Layout and Placement Plan: Submit slab joint layout and placement plan on a copy of the structural (not architectural) slab plan with defined floor joint locations, identifying the following:
1. Truck access locations and direction of concrete installation.
2. Include sequential number, width, length, slab placement area, and volume.
3. Construction joints. Install Sales slab concrete in one continuous monolithic placement without construction joints.

4. Review all joint locations and spacing defined in contract documents. Submission of slab joint and placement plan confirms contractor acceptance at these locations and spacing, providing the best opportunity to minimize out-of-joint crack mitigation.

F. Concrete Batch Plant Certifications: Name and address of the concrete supplier's batch plant and plant certification(s) by the National Ready-Mix Concrete Association or State Department of Transportation.

G. Mix Designs: Submit the proposed slab mix design (.pdf format) to the Architect for review at least 30 days before the commencement of slab concrete installations.
1. Complete and submit the Concrete Slab on Ground Mix Design Submittal Form included at the end of this section, including all requested information on the last page of the form.
2. Provide completed mix design submittals electronically in .pdf, unsecured format (maximum size 4 MB) to the Architect. **Do not combine other submittal items with the slab-on-ground mix document.**
3. Attachments to Concrete Mix Design: Include the following with the Concrete Mix Design submittal.
   a. Portland cement mill test reports.
   b. Designation type, quality, and source (natural or manufactured) of coarse and fine aggregate materials.
   c. Sieve Analysis Reports: Provide separate sieve analysis of percentages passing for coarse and fine aggregate, including data that produced values. Show values for each sieve size shown on the slab mix design form. Do not leave any line blank. Sieve analysis sampling and testing dates for each aggregate source must be within 60 days of the concrete submittal date.
   d. Aggregate Supplier Statement - stating if aggregates used can potentially cause pop-outs or other disruptions from aggregate reactivity or other mechanisms, based on test or past service.
   e. Product data for the following concrete materials admixtures:
      1) Water reducing.
      2) Set retarding.
      3) Set accelerating.
   f. Concrete compressive strength data as required by ACI 318.
4. Use the same concrete mix for all interior slab installations. The finisher shall confirm the concrete slab mix's placing, finishing, and setting characteristics before placing any Sales slab concrete.
5. The contractor is responsible for ensuring that the concrete materials supplied will produce the desired finished product as determined by the Architect and Sprouts. Reviewing the mix design by any designer of record or consultant does not relieve the contractor of this responsibility.

H. Concrete Installer’s Qualifications
1. Fill out and submit the Concrete Finishing Subcontractor’s Qualification Statement, which is included at the end of this section. If subcontracted by the concrete contractor, all previous project references shall be for the finishing contractor.
2. Include the fully completed statement in the General Contractor’s initial proposal for consideration in the selection process.

3. Sprouts Farmers Market reserves the right to reject any proposed concrete finish contractor.

I. Manufacturer's Certificate: Certify that reinforcement, steel, and accessories meet or exceed specified requirements.

J. Manufacturer's Installation Instructions: For concrete accessories, indicate the installation procedures and interface required for adjacent construction.

K. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view upon completion of concrete work.

L. Slab Protection Plan.

1.06 QUALITY ASSURANCE

A. Perform work of this section following ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Wash and scrub concrete slabs at any time after placement for an on-site inspection requested by the Sprouts Project Manager to determine compliance with this specification.
   1. Any slab portion that the Sprouts determines to be wholly unacceptable or defective shall be replaced immediately per the requirements. Minimum replacement shall be bound by original floor joints and may include additional areas to minimize differential finishing or color of adjacent slab surfaces.

1.07 WARRANTY

A. Manufacturer’s Warranty: Submit the manufacturer’s standard warranty document executed by an authorized company official for the Sprouts’ acceptance. The manufacturer’s warranty is in addition to, and not a limitation of, other rights the Sprouts may have under the Contract Documents.

B. Included in Section 016000 are additional requirements for product warranties.

1.08 CONCRETEING IN HOT, DRY, OR WINDY WEATHER

A. Follow ACI 305.1 specifications when concreting during hot weather with the following superseding additions or clarifications:
   1. Employ methods to avoid cracking when the evaporation rate of water from the surface exceeds 0.2 pounds per square foot per hour or when any combination of concrete materials and weather conditions are favorable for forming plastic shrinkage cracks.
      a. Whenever surface evaporation rate is, or anticipated to be greater than 0.15 lbs./sf./hr.:
         1) Use a specified evaporation retarder after the initial channel floating.
   2. Maximum concrete temperature as measured at the discharge point shall be 90ºF.

3. Cool ingredients before mixing to reduce the concrete temperature during placement. Using chilled water or chopped ice in mixing water to control the concrete temperature is acceptable. Calculate the water equivalent of the ice to the total amount of mixed water.
4. Only one slump adjustment, as defined in ASTM C 94.
5. Do not place concrete when forms, subgrade, aggregate base, or reinforcing bars exceed 120ºF. The temperature differential between the forms, aggregate base, or reinforcing bars and concrete will create conditions favorable for settlement cracks or thermal cracking.
6. Cover reinforcing steel with water-soaked burlap so the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

1.09 COLD WEATHER CONCRETE PLACEMENTS

A. Follow ACI 306.1 specifications when concreting during cold weather with the following superseding additions or clarifications:
1. Minimum base surface and ambient building air temperatures shall be 55ºF during placement and the five-day minimum curing period.
2. Do not place slabs on a subgrade or base over 20ºF cooler than concrete materials. Warm the subgrade or base to decrease the temperature differential to 20ºF or less.
3. The minimum concrete temperature measured at the discharge point shall be 60ºF.
4. Do not use unvented combustion heaters during concrete placement that can expose the concrete surface to excessive exhaust gases containing carbon dioxide (CO2) or carbon monoxide (CO). During slab placement and curing periods, maximum CO2 levels shall be 4,500 parts per million, and maximum CO levels shall be 50 parts per million at the concrete surface within 5 feet of any source of exhaust gases to minimize potential damage to concrete.

1.10 FIELD CONDITIONS

A. Enclosed Structure:
1. Place the Sales slab concrete within a completely enclosed structure with a watertight roof membrane installed.
2. Before placement, the roof construction, skylight installation, overhead painting, and roof drainage system shall be complete and weather tight.
3. Non-Sales (polished) and minimum concrete slab installations required for stud wall framing shall only require compliance with ACI 305.1 and 306.1 requirements, with additional focus on protection from wind and precipitation during and after placement to prevent damage.

B. Lighting:
1. Illuminate slab placement areas using fixtures suspended from the structure above, positioned and in quantity as necessary to achieve uniform lighting without distinct shadows.
2. Maintain a lighting level of at least 20-foot candles on concrete surfaces during placement and initial finishing.

C. Ventilation: Provide adequate continuous ventilation during all slab placements. The Contractor monitors CO and CO2 levels during concrete placement while ensuring a safe working environment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Subject to compliance with project requirements, provide products as manufactured by the following to the extent as specified hereinafter for the specific product:
1. American Decorative Concrete (800) 592-9320
2. Master Builders Solutions, (800) 628-9990.
3. BW Manufacturing, Inc., (616) 447-9076.
4. Convergent Concrete Technologies, (866) 375.2280
5. Dustless Technologies (800) 568-3949.
6. Fortifiber Building Systems Group, (800) 773-4777.
7. Goldblatt Industries, (877) 876.7562
8. Greenstreak Group, Inc., (800) 325-9504.
9. Kraft Tool Company, (800) 422-2448
10. L&M Construction Chemicals, (800) 362-3331.
11. PNA Construction Technologies, (800) 542-0214.
12. Raven Industries, Inc., (800) 635-3456.
13. Reliable Concrete Accessories, (855) 259-2662
14. Sika Corporation, (800) 933-7452
15. Soff-Cut, (951) 272-2330
16. SpecChem (866) 791-8700.
17. Stego Industries , (877) 464-7834.
18. Transhield (574) 742-4333
19. Unitex, (800) 821-5846.
20. W.R. Grace and Co., (713) 223-8353.
21. W.R. Meadows, Inc., (847) 214-2100.

B. Substitutions: Comply with the requirements of Section 016000 unless specified otherwise herein.

2.02 AGGREGATE BASE COURSE (A.B.C.)

A. Aggregate base material shall comply with local State DOT Standard Specifications for Dense Graded Aggregate material designated for road base application as follows:
1. 100% passing the 1½-inch sieve
2. 15% to 55% passing the No. 4 sieve
3. 5% to 12% passing the No. 200 sieve.

B. Recycled concrete base material shall be free of volatile organic materials, steel reinforcement, clay, brick, gypsum, or plastics.

2.03 FORMWORK

A. Formwork Design and Construction: Comply with ACI 347 guidelines and ACI 117 tolerances.

B. Furnish wood forms in the largest practicable sizes to minimize the number of joints and to conform to the joint system shown in Drawings.
   1. Dress forms on at least two edges and one side for tight fit.

2.04 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M Grade 60 (420).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished unless otherwise indicated.

B. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
   1. Mesh Size and Wire Gage: As indicated on the drawings.
   2. Flat sheets only.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage.
   2. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic-coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.05 DOWELS

A. At Construction Joints:
   1. Dowels shall consist of 1/4" smooth plate bars, ASTM A36 steel. Plate dowels shall be one of the following:
      a. Diamond Dowel System; PNA.
      b. Speed Plate System; Greenstreak.

2.06 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I, II, or ASTM C 595 Type 1L.

B. Fine and Coarse Aggregates: ASTM C 33, with the following additional requirements:
   1. Based on testing or past service, use only aggregates with no history of pop-outs or other disruptions from reactivity or other mechanisms when used for similar interior slabs on ground applications.
   2. No coal, lignite, or mica is acceptable in concrete slab mix.
   3. Meet fine aggregate grading requirements defined in section 6.1 of ASTM C33 without deviation unless approved.
   4. Use only natural (not manufactured) sand materials unless approved.
   5. The maximum aggregate sieve size shall be 3/4" or 1”. This sieve size must retain 1% to 5% passing in a combined gradation analysis of all blended aggregates.

6. Adjust proportions of coarse, intermediate, and fine aggregate to provide the following material proportioning characteristics unless otherwise approved:
   a. Coarseness Factor of 60 to 75%.
      1) The Coarseness Factor (CF) is the percentage of combined aggregate retained on the #8 sieve that is also retained on the 3/8-inch sieve.
      2) The Coarseness Factor (CF):
         CF = Aggregate retained on 3/8-inch sieve ÷ Aggregate retained on the #8 sieve.
   b. Adjusted Workability Factor.
      1) The Workability Factor (WF):
         The percent of combined aggregate that passes the #8 sieve.
      2) The Adjusted Workability Factor (Adj-WF):
         Adj-WF = WF + (Cementitious Material - 564lbs) ÷ 37.6.
      3) The range of accepted Adj-WF for a given CF:
         Adj-WF = (11.25-.15 CF) + 36.5 ± 2.5.
7. The total amount of blended intermediate aggregate (passing 3/8", retained on #8 sieve) shall not exceed 300 lbs/cy (1.85 cubic feet) unless necessary to meet the maximum specified Coarseness Factor.
8. Particle distribution requirements of ASTM C33 may be waived to meet the ranges specified.

C. Water: ASTM C1602.

D. Chemical Admixtures: ASTM C 494/C 494M.

E. No Supplementary Cementitious Materials:
   1. Do not use fly ash, slag, or other supplementary cementitious materials for exposed interior slabs.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength:
   1. Establish the required average strength for each type of concrete based on field experience or trial mixtures, as specified in ACI 301.

C. Portland cement:
   1. The minimum compressive strength shall be 3,500 psi at 28 days.
      a. The minimum required content is 520 pounds per cubic yard.
   2. Use only one cement brand throughout the project.

D. Maximum water/cement ratio of 0.53.

E. Total water content shall not exceed 300 lbs (36 gallons) per cubic yard.

F. Slump at the point of placement shall be 5" ± 1" unless approved otherwise.

G. Design the concrete mix to provide optimized placing and finishing characteristics for the given placement environment and available materials, producing a uniformly finished surface acceptable to the Sprouts representative.

2.08 CHEMICAL ADMIXTURES

A. Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by the manufacturer.

B. Do not use Type “F” or all-range water-reducing admixtures at Type “F” dosage rates. Use only one water-reducing admixture in any given mix. Water content shall produce a minimum 3-inch slump without admixture.

C. Do not use air entrainment admixtures in concrete materials that receive a trowel finish.

D. Do not use chemicals that will result in a total mix soluble chloride ion content of more than 0.1 percent by weight of cement.

2.09 MIXING

A. Measure and mix ingredients following the most stringent requirements of ASTM C94.

B. Ready-Mixed Concrete: Mix and transport following ASTM C94/C94M and ACI 301 except as specified.

2.10 UNDERSLAB VAPOR BARRIER

A. 15 mil thick, ASTM E 1745, Class A

B. Water Vapor Permeance: 0.01 perm, maximum, when tested following ACI 302.2R-06 recommendations.

C. Accessory Products: The vapor barrier manufacturer recommends tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in the vapor membrane.

D. Products:
1. Perminator; W.R. Meadows
2. Stego Wrap; Stego Industries
3. Vapor Block; Raven Industries
4. Vaporguard; Reef Industries

2.11 SALT AND LAITANCE CLEANER

A. CFE 2000; Ameripolish

B. Consolideck PreKlean; Prosoco

2.12 JOINTING PRODUCTS

A. Preformed Isolation Joint: Flexible closed-cell synthetic foam expansion joint strips, non-extruding, for the full depth of concrete.
   1. Products:
      a. Ceramar Flexible Foam Expansion Joint; WR Meadows
      b. Deck-O-Foam Expansion Joint Filler; WR Meadow
      c. Expansion Joint Filler; Master Builders Solutions

B. Joint Sealant and Primer: As specified in Section 079200.

2.13 EVAPORATION RETARDER

A. Water-based polymer, sprayable (during slab placement):
   1. Confilm; Master Builders Solutions
   2. E-Con; L&M
   3. SpecFilm; SpecChem.

2.14 CURING MATERIALS

A. Moisture Retaining Cure Cover (polished slabs).
   1. ReliableCure SOG; Reliable Concrete Accessories
   2. TopCure; Transhield
   3. UltraCure; Sika Corporation
   4. Substitutions: Not Permitted.

B. Moisture-Retaining Sheet: ASTM C171 (concrete to receive coatings or floor coverings)
   1. Polyethylene film, transparent or opaque, minimum nominal thickness of 0.0040 inch.

C. Reactive Curing Agent
   1. E-Cure; SpecChem
   2. Med-Cure; WR Meadows
   3. PCA Curing Agent; Ameripolish

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with the work of this section.

B. Verify that forms are clean before applying the release agent.

3.02 AGGREGATE BASE COURSE (A.B.C.)

A. Unless otherwise indicated on the Drawings, place aggregate base as specified herein.

B. Aggregate Base:

1. Install aggregate base in location and thickness shown on Drawings.
2. Compact to the final thickness shown on Drawings in layers not exceeding 6 inches with a minimum of 2 passes per layer with a vibratory compactor.
3. Compact fill to 98% of aggregate's Standard Proctor as determined by Method D of ASTM D 698.

C. Aggregate Base Fine Grading:
1. Compact to final thickness with two passes minimum vibratory compactor to produce smooth, flat, dense surface.
2. Use laser-guided equipment to establish specified base elevation.
3. Avoid excess moisture or soft soil beneath the vapor barrier when placing concrete.
4. Provide dry, smooth, flat, dense surface. Take corrective action if rutting or pumping is evident during the preparation of the soil support system.
5. Proof-roll for 48 hours at most before vapor barrier installation. The depression under a fully loaded concrete truck shall not exceed 1/2 inch.

D. Slab on Ground Aggregate Base Fine Grade Toleranec: -3/4 inch with transition no greater than 3/4 inch vertically to 8 inches horizontally for level slab.

3.03 VAPOR BARRIER INSTALLATION

A. Install vapor barrier following ASTM E 1643, except that Paragraph 10 – Slab Moisture Content provisions shall not apply.

B. Install the vapor barrier directly under the slabs, as shown on the Drawings, after an independent testing service has completed an acceptable base material proof rolling.

C. Following leveling and tamping the prepared base for slabs, place the vapor barrier sheeting with the largest dimension parallel to the placement direction.

D. Lap joints 6 inches minimum and seal continuously with specified tape.

E. Seal punctures and tears in the membrane caused by bar chair feet, screed anchors, or utility penetrations with specified tape.

3.04 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301.

B. Clean reinforcement of loose rust and mill scale, accurately position, support, and secure in place to achieve the minimum concrete coverage required for protection.

C. Install welded wire reinforcement at the maximum lengths, offset end laps in both directions, and splice laps with tie wire.

D. Accurately place anchors, seats, plates, reinforcement, and other items cast into concrete, positioned securely and not interfering with concrete placement.

E. Secure dowels and their sleeves (if applicable) perpendicular to the joint and parallel to the finished concrete surface.

1. Install plate dowels at all construction joints at 24-inch centers following the manufacturer's recommendations unless noted otherwise on the drawings.
2. Use the manufacturer's alignment apparatus to install within specified tolerances.

F. Install reinforcement, inserts, embedded parts, and formed construction joint devices to prevent displacement during concrete installation.

G. The utility rough-in connections and fixtures locations shall be as follows for the Sales area concrete slab placement only:
1. Plumbing fixtures are installed and secured at the finish floor elevation to allow continuous finishing operations over these fixtures with riding trowel machines without the buildup of concrete materials while producing a uniform finish around them.
2. Electrical boxes, including "Walkerduct" extensions, are installed 3/8" below the finish floor to eliminate any impedance of continuous trowel finishing above
3. Refrigeration lines are installed 3/8" below the finish floor within a foamed-filled 8" maximum-size PVC access pipe block out.
4. Applicable trades shall install identification markers to retrieve all buried fixtures after concrete placement. Ensure that all markers will not damage the adjacent concrete surface during finishing.
5. The concrete finisher shall validate proper elevations of these connections and fixtures before concrete installation.

3.05 CONVEYING

A. Manage concrete from mixer to place of final deposit as rapidly as practicable and in a manner that will ensure obtaining specified quality of concrete.

B. Discard concrete which has already begun to set. Do not re-temper with water.

C. All concrete materials for interior slabs on ground shall be placed via buggies or belt conveyed to the point of placement in the most expeditious, continuous manner that ensures seamless consolidation without cold joints. At least six (6), minimum 1/2 cubic yards, fully operational buggies shall be on-site immediately before concrete placement. Pumping concrete materials is not acceptable for Sales slabs unless approved for unique circumstances.

3.06 PLACING CONCRETE

A. Schedule the Sales area concrete slab placement as late as possible in the construction schedule.

B. Notify SSI at least five (5) days before commencement of placement operations. An SSI representative must be on site for the entire installation of the Sales slab placement.

C. Unless otherwise specified, place concrete following the requirements of ACI 301.

D. The following personnel must be present during all slab placements:
1. General Contractor's Superintendent.
2. Concrete Subcontractor's Finish Foreman
3. At least three ACI Flatwork Certified Finisher & Technician (or Tradesman) or equal experience and skill.

4. Concrete Supplier's Quality Control Representative.
5. Sprouts Testing Laboratory.
6. Plumber, Electrician, and Refrigeration contractors.

E. Do not place concrete over standing water, mud, frost, ice, or snow.

F. All concrete shall be delivered from only one concrete batch plant for any given day's placement. Use the same concrete plant for all interior slab placements unless approved in writing before the change.

G. Complete the concrete installation within 90 minutes of introducing the mixing water to batched materials.

H. Manage the installation process, including materials delivery, labor, and conveying methods, to ensure a continuous monolithic deposit without placing fresh plastic concrete adjacent to hardened concrete, creating cold seams or joints.

I. Consolidate and screed concrete slabs on ground using a ride-on, vibrating laser screed.
1. Laser screed must have a minimum strike-off head width of 12' and boom reach of 20'.
2. A fully operational backup laser screed must be on site for Sales slab placement.
3. Check the laser screed level head at least three (3) times during each pour. Use a feeler gauge to measure deviations. If deviations are present, replace the head with a new straight one.
4. Other vibratory screeding methods are acceptable only in areas where laser screed is not accessible and approved in writing.

J. Use internal vibration along construction joints at both formed and slab abutments. Vibrate under plate dowels. Adequately mark forms to locate dowels after concreting.

3.07 CONCRETE FINISHING

A. General:
1. Provide a dense, smooth, trowel-finished surface, uniform in color and profile.
2. Finish the surface to produce a uniform sheen free of scratches and visible or raised trowel marks.
3. Finishing methods shall produce the same density and final surface color across formed construction joints. Take measures to avoid scratching the originally placed slab surface while installing the second slab placement.
4. Riding finishing equipment shall extend over the formed edge for the first slab placement. Use the same finishing techniques for the second slab placement up to the abutting joint and around the case drains and columns, minimizing hand finishing.
5. Do not ride trowel machines on existing hardened concrete slabs. Carry trowels off slab surfaces.
6. Do not add water to any slab surface during finishing operations.
7. Do not add cement to any slab surface during finishing operations.
8. Do not perform finishing operations while water is on the slab surface.

B. Equipment:

1. Provide a minimum of five ride-on finishing machines, eight (8) feet or larger, fully operational, clean of any debris, hardened concrete splatters, dripping oil or grease, on-site and available for all slab placements as follows:
    a. 2 machines equipped with floating pans.
    b. 2 machines equipped with steel trowel or combination blades
    c. 1 machine equipped with steel-reinforced, plastic finish blades
        1) ("Poly Pro" plastic blades; Wagman Metal Products).
2. For each installation, use new finishing blades and pans free of rust, dirt, or hardened concrete.
3. Provide at least one operating, 24" or 30" walk-behind edge finishing machine with a rotating guard ring.
4. The contractor shall provide necessary backup equipment to ensure continuous depositing and installation of materials that prevent delays and the potential for placing fresh concrete adjacent to previously hardened materials.

C. Initial Leveling and Aggregate Consolidation:
1. Immediately after Laser Screed strike-off, use a double roller tamp (minimum 36" wide) to consolidate the coarse aggregate below the concrete surface, as manufactured by:
    a. Goldblatt Industries
    b. Kraft Tool Company
    c. Approved equal.
2. Use mesh hand tamp around columns and along bulkhead edges where roller tamp does not reach.
3. Next, use a 6 to 12-foot-wide minimum channel float or check rod (not a bull float).
4. After initial leveling of the slab surface, all further floating shall be completed with pans, except for "boarding" edges at construction joints. Do not use bump cutters or straight edges to cut high points anytime during placing and finishing.

D. Hand and Power Floating:
1. Power float the floor with pans before troweling.
2. Do not start floating until:
    a. Bleeding is complete, and water is gone, including water sheen on the slab surface.
    b. Concrete has stiffened to the point where rotating power float blades are not throwing mortar.
3. The finisher shall determine the proper time to start finishing procedures for interior slab placements as follows:
    a. The typical setting characteristics of concrete materials will allow initial power floating to begin 3-1/2 hours ± 1 hour after batching. At that time, the concrete should support a finisher on foot without more than a 1/8-inch indentation in the slab surface when using ride-on power trowels and a 1/4-inch indentation using walk-behind edge machines along walls, pipes, and columns.
    b. Variations in ambient and concrete material temperatures will cause setting behavior to fluctuate. It is the responsibility of the purchaser of the concrete materials to validate that the placing, finishing, and setting characteristics of the materials will produce the desired finished product.
4. Do not use the following tools for floating:
    a. Power troweling machines with trowel blades.

b. Fresno or similar wide metal trowel.

5. Float three times minimum, with each floating at right angles and 45 degrees to the previous floating and the final pass at 90 degrees to the last pass.

E. Troweling for Interior Slabs:
1. For the first troweling, keep the blades as flat as possible and use low speed, minimizing surface “twisting,” “washboard,” “chatter marks,” or “pitting.”
2. Trowel at least two times, with the first two trowelings at right angles. Cease troweling before trowel blades scratch the surface.
3. Allow time between troweling passes for the concrete to stiffen and the water sheen to disappear, ensuring adequate continuous finishing of the slab surface to avoid early sealing or crusting
4. Keep trowel machines continuously moving during trowel finishing to avoid permanent surface discoloration.
5. Darkened spots, smeared, or blotchy finishes, typically from troweled-over knots or mortar deposits thrown from the finishing machine, are unacceptable.
6. Ensure kneeboard impressions, trowel marks, footprints, or chattered areas are not evident after floor completion.
7. All exposed in-service concrete slab surfaces, beyond 21 days after placement, shall have a minimum Mohs’ hardness of 5.5 when measured using the following test method or approved equivalent:
a. “Deluxe Hardness Picks” manufactured by Mineralab, LLC, (800) 749-3766.

F. Surfaces to Receive Thick Floor Coverings:
1. Includes quarry tile, ceramic tile, and terrazzo with a complete bed setting
2. ACI 302 Class 1 - "Float" finish.

G. Surfaces to Receive Thin Floor Coverings:
1. Includes carpeting, resilient flooring, seamless flooring, thin-set quarry tile, and thin-set ceramic tile.
2. ACI 302 Class 2 - “Light-troweled” finish. Uniform “haze” finish without burn marks, meeting the surface tolerance requirements.

H. Surfaces to receive Polished Finish:
1. ACI 302 Class 3 - “Light-troweled” finish using steel-reinforced plastic blades for the final pass. Uniform tight finish without burn marks, meeting the surface tolerance requirements.

I. Other Exposed Concrete Wearing Surfaces:
1. ACI 302 Class 5 - "Steel-troweled” burnished finish.

3.08 SLAB JOINTING

A. General:
1. Provide construction, isolation, and contraction joints as indicated in the drawings and noted below.
2. As appropriate, install joints straight, perpendicular, or parallel to building lines, column lines, and slab edges.

3. Joints shall form rectangular panels with the long side less than 1-1/2 times the length of the short side.
4. Locate contraction joints at reentrant corners when possible.
5. Coordinate with placement of joints in tile surfaces.

B. Construction Joints:
1. Use a minimum of 1-1/2-inch dimensional form lumber, with the top outside edge beveled at 30 degrees, leaving a 3/8-inch to 1/2-inch level surface.
2. After removing the bulkhead (form), lightly stone the top slab edge to remove any protrusions that may prevent a seamless abutment when adjacent concrete is placed.
3. After the concrete is fully cured, and before joint filling, saw cut the joint to provide a ledge to receive filler material. Maintain the sawed joint in accurate alignment with the initially formed construction joint, allowing the joint to open a minimum 1/16-inch width at the time of cutting. Cut to a minimum depth of 1 inch unless otherwise indicated.

C. Isolation Joints: Use a specified preformed joint filler with a total height greater than the slab thickness, resting on the base and protruding above the finish floor, ensuring complete isolation of column steel and concrete slab.

D. Contraction Joints:
1. As soon as practical after the slab has hardened, provide early entry saw cut joints as indicated on drawings. Avoid raveling of the sawed joint edge caused by early cutting.
2. Use non-staining chalk to mark all locations of saw cut lines.
3. Employ enough saws and workers to complete cutting saw joints before shrinkage produces cracking. Provide at least two saws with specified vacuums on site with blades capable of achieving the required depth of saw cut with operating vacuums for each saw.
4. Saw cut to a maximum width of 1/8 inch by 1/4 the slab depth.
5. Extend the sawed joint to the slab boundaries and abutments, including columns, drains, and other penetrations in the path of a defined joint.

E. Saw-Cut Joint Dust Collection (for exposed concrete slabs):
1. Prevent all sawing residue from scratching or collecting on the slab surface.
2. Apply new 2” wide Velcro tape across the bottom of the saw plate, fabric side only, for each day of sawing.
3. Connect a specified dust collection system directly to each saw.
    a. Dust Collection System:
        1) Pulse Vac; BW Manufacturing.
        2) DustDroid; Dustless Technologies.
        3) Soff-Vac; Husqvarna USA.
        4) Substitutions: Not permitted.
4. Immediately clean any remaining residue after cutting before cure.

3.09 TOLERANCES

A. Conform to most stringent requirements of ACI 117 and ACI 301 except as specified herein.

B. Floor Flatness F(F) and Floor Levelness F(L) tolerances for trowel-finished slabs per ACI 117 as follows:

1. The minimum local area shall be bound on each side by column lines.
2. Interior Floor Slabs on Ground: Specified Overall Value (SOV) F(F) 50 / F(L) 35 and Minimum Local Value (MLV) F(F) 34 / F(L) 24.

C. Dowels:
1. Install dowels within plus or minus 1/8” in dowel alignment in vertical and horizontal planes.

3.10 CURING AND PROTECTION

A. Comply with requirements of ACI 308.1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Polished, Exposed Slab Surfaces
1. Including exposed polish mock-up area.
2. Immediately after finishing is complete, saturate exposed concrete surfaces with water for 30 minutes for preconditioning.
3. Apply Moisture Retaining Cure Cover with edges lapped 3 to 4 inches, sealed and secured to prevent moisture from escaping from concrete from laps or edges following the manufacturer’s recommendations.
4. After laying the cure cover, use the manufacturer-furnished roller squeegee or push broom to ensure uniform contact between the curing cover and slab, eliminating all air pockets and creases.
5. The slab surface shall remain saturated for the five (5) day curing period after placement.
6. Do not allow the slab surface to dry before initial cleaning.
7. After the curing period, remove the cure cover in sections immediately before scrubbing the saturated slab surface. Remove only enough sheets to allow proper scrubbing before the slab surface dries.
8. Immediately scrub the floor surface with a proper salt and laitance cleaner, mixed with clean water, removing all soluble salts at the surface. Scrub and vacuum as often as necessary to remove all laitance and residue in a soluble state before hardening of materials that can discolor the slab surface.
9. Properly dispose of used cure covers. Do not reuse.

C. Non-Polished, Exposed Slab Surfaces
1. Apply curing agent before saw-cutting joints and as soon as the concrete surface will allow without damage, in accordance with the manufacturer’s requirements.
2. Do not allow the compound to accumulate and puddle. If whitening from overapplication occurs, consult the manufacturer for removal of the product with hot water and aggressive scrubbing.

D. Slabs and Floor areas to Receive Adhesive-Applied Flooring
1. Apply polyethylene film sheet material with edges lapped 6 inches minimum without adding water to the surface.
2. After placing the sheet materials, leave them in place for three days, remove them, and clean the slab surface.
3. Dispose of used sheet material. Do not reuse sheet material.

E. Traffic Limitations after Slabs on Ground Placement:
   1. Barricade concrete surfaces immediately after placing and finishing.
   2. During construction, do not store materials on slab surfaces that will remain exposed as a finished product.
   3. Do not allow foot or vehicular traffic until cure covers are removed and the slab surface is cleaned five (5) days after placement.

3.11 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000.

B. Provide free access to concrete operations at the project site and cooperate with the appointed firm.

C. Maintain records of concrete placement. Record the date, location, quantity, air temperature, and test samples taken.

D. Test concrete materials as follows:
   1. For every 50 cubic yards of concrete placed:
      a. Perform one slump test - ASTM C143/C143M.
      b. Measure concrete materials temperature - ASTM C1064.
      c. These tests will be conducted from materials initially discharged to allow for adjustments to the entire truckload, if necessary.
   2. For every 100 cubic yards of concrete placed:
      a. Compressive Strength Tests - ASTM C39/C39M.
      b. Measure air content - ASTM C173/231.
   3. Complete all the above tests for the first concrete truck delivered.

E. Flatness and Levelness Testing:
   1. Test interior floor slabs for flatness and levelness following ASTM E 1155, including as specified herein:
      a. Conduct surface profile testing before saw cutting for each day’s placement.
      b. Approved Instruments:
         1) Axiom 1155 Floor Profiler manufactured by Somero Matson Group.
         2) Dipstick Floor Profiler manufactured by Face Construction Technologies.
         3) D-Meter Floor Profiler by Allen Face & Associates.
      c. F(F)/F(L) minimum overall for a composite of measured values (Specified Overall Value - SOV) for the entire day’s concrete placement and F(F)/F(L) minimum for any individual floor section (Minimum Local Values - MLV) as specified.
      d. Bound individual floor sections for testing purposes by providing the smallest sections: construction joints, contraction joints or columns, and half-column lines.

F. Test Results
   1. The testing agency shall report findings verbally to the Contractor immediately and written results to the Sprouts, Architect, and Contractor within 24 hours of the test.
   2. If the initial test results deviate from the specified requirements, confirm deficient areas of floors through immediate additional testing in those areas.

3.12 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements for uniformity of finish, surface scratches, and gouges.

B. The Sprouts may direct the Contractor to remove and replace concrete for one of the following (but not limited to) conditions:
   1. Slab surfaces measuring below the minimum required SOV or MLV F(F) / F(L) values.
   2. All cracked panels in slabs to receive a polished finish.
   3. Visible cold joints and “mend lines” from delays in depositing and consolidating the concrete materials.
   4. Excessive differential surface coloration of the slab surface due to finishing, curing, or improper protection of the slab surface.
   5. Differential finish consistency, tiger striping, pitting, or voids.

C. The Contractor shall bear all costs associated with remedies for defective concrete, including extra testing and consulting as required. The Sprouts may take credit for the value of corrective work in place of further delays to the project schedule.

D. Do not patch, fill, touch up, repair, or replace exposed concrete except upon the express direction of the Architect, Sprouts, or SSI.

3.13 PROTECTION

A. General Contractor to provide a written “Slab Protection Plan” before the pre-installation meeting for approval, including, but not limited to, the following items:
   1. All exposed polished slab areas shall be barricaded with cones. Sub-contractors and Vendors will only be allowed in these areas if authorized and required to complete contracted work. Product storage is not permitted in these areas.
   2. Clean the slab surface daily, removing all stored product, dust, and debris without damaging it.
   3. Develop spill cleanup kits and identify locations where they are found in the store.
   4. All equipment allowed on the slab surface will require:
      a. Diapering
      b. Non-marking tires.
      c. The operator must inspect twice daily for leaks and any dragging items that may damage the concrete surface.
      d. Inspect tires for embedded nails, screws, or rocks before each use.
   5. Protect concrete slabs from discoloration, staining, gouges, and scratching.
   6. Only charge equipment batteries in non-polished back storage areas, with concrete surfaces protected from potential spills.
   7. Protect from all paint overspray using only breathable materials.
      a. Temporarily use breathable material such as EZ-Cover, Ramboard, or Econocover for protection in high-traffic locations. **DO NOT USE TAPE APPLIED ABOVE OR DIRECTLY ON THE SLAB SURFACE AT ANY TIME**.
      b. Do not store building materials, soil, chemicals, or equipment on permanently exposed slab surfaces.
      c. Do not allow pipe-cutting machines on the slab.

B. Distribute a slab protection plan for review by all subcontractors and vendors working around or near the interior concrete slabs. A poster-size copy of this plan shall be visible at least four locations inside the store after concrete slab installation and before store turnover.

END OF SECTION 033100

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CONCRETE FINISHING SUBCONTRACTOR'S QUALIFICATION STATEMENT

Store Location: _____

Store #:_____

Date: _____

By signing below Contractor confirms that the concrete finishing subcontractor meets the following requirements:

The concrete floor finishing subcontractor's crews have experience in finishing exposed retail concrete floor slabs that received an exposed aggregate polished finish of **similar size and scope** in at least 5 previous projects as listed below (provide references completely installed and finished by finishing subcontractor)

	Project Description (Owner, Store #)	Location (Address, City, ST)	Area (s.f.)
1.			
2.			
3.			
4.			
5.			

General Contractor Name: _____

General Contractor Address: _____

Signature of Responsible Officer: _____ Cell: _____

Typed Name and Title of Officer: _____ Email: _____

Concrete Finisher Name: _____

Concrete Finisher Address: _____

Signature of Responsible Officer: _____ Cell: _____

Typed Name and Title of Officer: _____ Email: _____

** Submit one copy of this Statement to the Architect for review.

CONCRETE SLAB ON GROUND MIX DESIGN SUBMITTAL FORM

STORE INFORMATION	
STORE #	
ADDRESS	
CITY, ST	
CONTRACTORS	
GENERAL	
CONCRETE	

A. CONCRETE INFORMATION

Supplier Mix Design # _____

Design Strength (f'c) _____ psi

Water / Cementitious Ratio _____

Total Air Content _____ %

Mix Developed From:
☐ Trial Mix Test Data (*attach test data*)
☐ Field Experience

Density
Wet _____ pcf Dry _____ pcf

Slump
"_____ (± 1") **WITHOUT** WR Admixture

"_____ (± 1") **WITH** WR Admixture

B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces) oz / cy	oz / cwt
Water Reducing				
Accelerating				
Retarding				
Liquid Color				

C. MIX DESIGN

Mix Proportions (per cubic yard)

	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	**Volume** (cu ft)	% Aggregate Absorption
Cement					
Coarse Agg. #1					
Slag					
Coarse Agg. #1					
#2					
#3					
Fine Agg. #1					
#2					
Water					
Air Content					
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	**% Passing Each Sieve** (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2	Cumulative	Individual	
1-1/2"								
1"								
3/4"								
1/2"								
3/8"								
# 4								
# 8								
# 16								
# 30								
# 50								
# 100								
# 200								
% of Vol								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained 3/8" sieve}}{\text{Combined \% cumulative retained \#8 sieve}}$	=
Workability Factor =	Combined % passing #8 sieve	=
Adj-Workability Factor =	WF + [(Cementitious Material - 564) ÷ 37.6]	=

Allowable Adj-WF=	Adj-WF = [(11.25 - .15 CF) + 36.5] ± 2.5	=	Low	High

D. **ATTACHMENTS:** Include the following with this Mix Design Report.

☐ Portland Cement mill test reports

☐ Separate aggregate gradation reports including all required sieve sizes

- All gradation sieve report tests dated within 60 days of this report
- Report for each coarse and fine aggregate material in mix

☐ Statement of potential pop-outs or other disruptions from aggregate reactivity or other mechanisms.

☐ Product data for the following admixtures:

Water reducing
Set retarding or set accelerating
Liquid Color admixture (manufacturer, product, color designation, dosage - lbs/cy)

☐ Concrete compressive strength data used for standard deviation calculations

E. CONCRETE SUPPLIER INFORMATION

Company Name	_____	Tel. # ( ) _____
Address	_____	
City, ST Zip	_____	
Technical Contact	_____	Cell # ( ) _____
		e-mail _____
Sales Contact	_____	Cell # ( ) _____
	PRIMARY PLANT	SECONDARY PLANT
Plant Location:	_____	_____
Miles from Site:	_____	_____
Travel Time to Site:	_____	_____
NRMCA Certified:	☐ YES ☐ NO	☐ YES ☐ NO
State DOT Certified:	☐ YES ☐ NO	☐ YES ☐ NO
Batch Mixing Type:	☐ DRY ☐ CENTRAL MIX	☐ DRY ☐ CENTRAL MIX

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SECTION 033543
POLISHED CONCRETE FINISH AND JOINT FILLER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Polished Concrete Flooring System – CPC Definition 101.0.

B. Filler and Sealant for All Interior Slabs on Ground Joints.

C. Reactive Surface Densifier and Protectant(s) for all exposed concrete slab surfaces (including non-polished slabs).

1.02 RELATED REQUIREMENTS

A. Section 013000 – Administrative Requirements (Submittal Procedures.)

B. Section 014000 – Quality Requirements.

C. Section 016000 – Product Requirements.

D. Section 017700 – Closeout Procedures.

E. Section 033100 – Cast-in-Place Interior Concrete Slabs on Ground.

F. Section 079200 – Joint Sealants.

1.03 REFERENCE STANDARDS

A. ASTM International
1. D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces
2. D523 - Standard Test Method for Specular Gloss
3. D1455 – Standard Test Method for 60º Specular Gloss of Emulsion Floor Polish
4. D5767 - Standard Test Methods for Instrumental Measurement of Distinctness-of-Image Gloss of Coating Surfaces
5. D4580 Measuring Delamination
6. F2170 - Standard Test Method for Relative Humidity in Concrete Floors
7. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

B. Concrete Polishing Council (CPC)
1. Bonded Abrasive Polished Concrete Definition D101.0.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Concrete Consultant
   1. Sprouts Farmers Market (Sprouts) has contracted Structural Services, Inc. (SSI) to provide consultation to Sprouts, AoR, and EoR as defined in Section 033543. SSI can be reached at 214-522-6438 or sprouts@ssiteam.com.
   2. Any recommendations or changes discussed with SSI must be approved in writing through RFI submission before implementation. SSI does not have direct authority to change any requirements of the contract documents or to approve any portion of the work.

B. Coordinate with Section 033100 to schedule and coordinate this section's work, including the concrete finish troweling and curing of the concrete slab.

C. Coordinate where possible to finish this section before the construction of vertical obstructions due to the difficulty of bringing floor polish flush to walls and obstructed areas.

D. Pre-installation Meeting: See Section 033100 for requirements.

E. The General Contractor shall post a slab protection plan large enough for workers to view at the front entrance and on several columns inside the building.

1.05 SUBMITTALS

A. See Section 013300 - Submittal Procedures.

B. Product Data: Manufacturer's published data on each polished concrete product, including information on compatibility of different products and limitations.
   1. Manufacturer and model of polishing equipment, including the amount and types of grinding heads, saws, dust extraction systems, and polyurea joint filler pump.
   2. The diamond tooling manufacturer’s grinding guide chart details the appropriate selection of diamond tooling for various concrete surface hardnesses.
   3. Reactive surface densification and solvent-based penetrating protectant system.
   4. Pit Grout Coat material for filling pits, voids, and cracks.

C. Furnish one complete submittal document for review that includes datasheet information for all items requested in the checklist at the end of this section.

D. Furnish written dust/water/slurry control and disposal plan to ensure compliance with all local, state, and federal guidelines and regulations for review. A copy of this plan shall be maintained at the job site with compliance with execution verified by the General Contractor.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this Section and approved by the manufacturer.
   1. **BEFORE BIDDING, CONTACT THE SPROUTS PROJECT MANAGER FOR THE POLISHER ASSIGNED TO YOUR SPECIFIC PROJECT. ONLY THIS POLISHER CAN BID ON THE PROJECT.**

2. All work specified in this section shall be completed by the assigned contractor, utilizing only laborers who are experienced artisans specializing in current methods of ground and polished concrete flooring systems comparable in type, scope, and quality and are directly employed by this contractor

1.07 MOCKUP

A. SSI shall be present for the mockup installation to observe all steps necessary to produce the specified polish finish. Notify SSI at least ten (10) days before the commencement of placement operations so a placeholder date for the mockup is scheduled 21 days after the sales floor slab placement. Notify SSI if this date changes.

B. Complete the mockup installation with the same equipment and crew to perform all polish work. Provide all operating equipment and tooling necessary to perform all the required steps, including edging equipment.

C. In a location designated by SSI, provide a fully polished mockup covering a minimum area of 200 sq feet, including joint filling (and, if needed, pit grout application) per all requirements of this specification.

D. Mockup will also be located next to a wall, a column, or a penetration, such as a sink drain, and the contractor shall demonstrate a seamless grind and polish transitioning from the floor to the wall. Include the proper preparation of the joints and complete filling of the contraction joint as part of the polish processing over one or more floor joints. Fill joints, allowing enough time to cure before the 7:00 am starting time of the mockup, typically the evening before.

E. Provide a mockup in an area with lighting of a similar type and wattage to those the store will use when in operation.

F. As directed, provide up to two additional mockups where necessary to compare finishes or obtain approval.

G. During the mockup, SSI will determine whether a specified pit grout coat is required and then receive approval from a Sprouts Project Manager. The contractor shall have pit grout materials and pigment packs in Ryno or Gauntlet gray available for all mockups.

H. The Contractor shall use pre-conditioned (previously used) diamonds and have a complete range of tooling available for various concrete surface hardnesses. The contractor should also be capable of grinding and honing either wet or dry, producing a scratch-free surface.

I. Maintain the approved mockup as the standard for work in this Section. Unless approved otherwise, use the same grinding and polishing process as approved in the mockup for the entire polish work.

J. SSI will validate surface aesthetic measurements for the mockup, taking measurements before and after applying a solvent-based penetrating surface protector. SSI will sign off on the mockup as the acceptable surface aesthetic and aggregate exposure that should be the standard for all polished slab areas. If the Contractor cannot meet the specified measurable requirements, they must change the process or tooling until the 60° gloss, DOI, and haze requirements have been met.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

B. Storage:
   1. Store materials indoors in a clean, dry area per the manufacturer’s instructions and MSDS sheets.
   2. Keep materials from freezing.

C. Handling: Protect materials during handling and application to prevent contamination or damage.

1.09 FIELD CONDITIONS (PROVIDED BY THE GENERAL CONTRACTOR)

A. The Polishing Contractor will be provided complete access to 50% of the entire area to be polished for five (5) consecutive days, 24-hour availability, without any other trades working in this area that are free of stored or installed products or fixtures. The entire polished area shall be divided at the mid-point in either direction to provide two contiguous rectangle work areas.

B. Maintain a minimum lighting level of 30-foot candles at 8 feet above the floor surface over each 20-foot square area of the finished floor.

C. All necessary electrical service must be provided within 100 feet of the work area for all polishing equipment, including three-phase 480-volt service as needed.

D. Maintain ambient temperature in conformance with the manufacturer’s instructions.

E. Roof construction, skylight installation, overhead painting, and roof drainage system shall be complete and weather-tight before concrete is placed and maintained.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Comply with current Federal, state, and local air quality regulations and Federal requirements on concrete silica dust emissions. Limit and control dust and moisture created by concrete surface enhancement work to meet all local, state, and Federal ordinances, codes, and laws.

B. Comply with current Federal, state, and local safety and environmental regulations for construction and demolition waste management and disposal.

C. Limit and control damage from slurry caused by surface preparation and the polishing process

D. Upon completion of densifier and stain protectant use, dispose of excess materials.

1.11 WARRANTY

A. See Section 01700 - Closeout Procedures for additional warranty requirements.

PART 2 - PRODUCTS

2.01 Manufacturers

A. Subject to compliance with project requirements, provide products and equipment by the following:
1. 3M (888) 364-3577
2. Ameripolish (800) 592-9320
3. Boride Engineered Abrasives (800) 662-0336
4. DRC Industries (866) 365-1001
5. Eagle Solutions (800) 633-0519
6. Gorilla Concrete Tools (440) 236-5112
7. Hi-Tech Systems (800) 454-5530
8. HTC (877) 482-8700
9. Husqvarna (800) 288-5040
10. Joe Due (608) 847-6627
11. Metzger/McGuire; (800) 223-6680
12. Minuteman (800) 323-9420
13. Norton (800) 331-3604.
14. Onyx (800) 858-3533
15. Pioneer Eclipse (800) 367-3550
16. Prosoco (800) 255-4255
17. Pullman-Ermator (800) 232-2635
18. Ram Board (818) 848-0400
19. Rubbermaid Commercial Products (800) 347-9800
20. Runyon Surface Prep 317-559-2699
21. SASE (800) 522-2606
22. Solid Solution Products (SSP Polymers) 714-603-7390
23. SpecChem 816-968-5600
24. U.S. Saws (866) 987-7297

2.02 CONCRETE FLOOR FINISH APPLICATIONS

A. Installation of polished concrete floor system for new interior concrete floors by grinding, honing, and polishing with various size grit metal-, resin- and ceramic-bonded diamonds and applying concrete densifier and solvent-based penetrating surface protectant.

B. Reactive densifier and solvent-based penetrating surface protectant(s) shall be products from the same manufacturer.

2.03 SALT AND LAITANCE CLEANER

A. CFE 2000; Ameripolish

B. Consolideck PreKlean; Prosoco

2.04 REACTIVE DENSIFIER

A. 3D HS Densifier; American Decorative Concrete

B. Blended Densifier; Prosoco

C. D2; SASE

2.05 SALT PROTECTION (LOCATIONS SUBJECT TO DEICING SALTS)

A. 244 Salt Screen Additive; Prosoco

B. 3D HS; American Decorative Concrete

2.06 SEMI-PENETRATING SURFACE PROTECTANT

A. 3D SP; American Decorative Concrete

B. LS Guard; Prosoco

C. ProtectSelect; SASE

2.07 PENETRATING SURFACE PROTECTANT

A. Consolideck Concrete Protector SB; Prosoco

B. SPR3; SASE

C. SR2; American Decorative Concrete

2.08 PIT GROUT COAT MATERIALS

A. Quick Mender XO, VersaFlex

B. Rapid ReFloor Pit Grout, Metzger/McGuire

C. Spall TX3, Hi-Tech Systems

D. Camo Patch UV Solid Solution Products

E. Patch Crete Pure Solid Solution Products

2.09 INTERIOR FLOOR JOINT FILLER

A. Rapid setting polyurea polymer, 100% solids, multi-component, semi-rigid.

B. Color: To be selected by SMF PM from the manufacturer's standard range.

C. Applications: Use for:
   1. All interior joints in exposed concrete slabs, including polished surfaces.

D. Products:
1. PE85; Hi-Tech
2. SL/85; VersaFlex
3. Edge-Pro 80; Metzger/McGuire

2.10 JOINT FILLER PREPARATION SAW (DUSTLESS, DRY-CUT).

A. Dust Buggy; U.S. Saws

B. GCT Tank 10" Dustless Concrete Joint Saw; Gorilla Concrete Tools

C. Humpback Cutter; Joe Due

D. Perfect Trac; Metzger/McGuire

2.11 POLISHING EQUIPMENT

A. Field Grinding and Polishing Equipment:
1. Variable speed, containing 3-heads minimum (planetary, counter-rotating) that contour to the concrete slab surface.
2. Must produce a minimum of 600 pounds of head pressure.
3. For the duration of the work, provide a minimum of four fully operational machines with a head diameter of 30 inches or greater.
4. If dry grinding, honing, or polishing, use dust extraction equipment with a flow rate suitable for dust generated, with squeegee attachments.

B. Dust Extraction System:
1. Heavy-duty industrial HEPA filtration vacuum system, suitable for extracting and containing large quantities of fine concrete dust (minimum 350CFM air flow) in conjunction with manufacturer-recommended pre-separator. A pre-separator is mandatory for all metal bond cuts when grinding dry.
2. Provide one of the following:
a. 86D; HTC
b. T8600; Pullman-Ermator
c. Bull 1250; SASE
d. Approved Equal

C. Diamond Grinding Segments:
1. Provide diamond grinding segments from one of the following:
a. Boride Engineered Abrasives
b. Husqvarna
c. SASE
d. Runyon Surface Prep
e. Approved Equal
2. Allowable Grinding/Polishing Diamonds (or manufacturer’s equivalent designations).
a. Metal Bonded Diamond Grit Sizes: 25, 40, 80, and 150.
b. Hybrid Style Diamond: 30, 50, 100, 200.

c. Resin-bonded, Phenolic Diamond Grit Sizes: 100, 200, 400, 800, 1500, and 3000 to achieve the specified gloss.

3. Grinding/Polishing Pads for Edges.
   a. Exposed floor surface, requiring handwork, where larger machines cannot reach.
   b. Provide the same progression of diamond grit sizes used for primary machine grinding/polishing.
4. Progression of all polishing steps shall include sequential grit sizes not greater than twice the previous grit used.

D. Burnishing Equipment: High-speed walk-behind or ride-on machines.
1. Propane type.
2. 22-pound head weight (40-pound maximum).
3. Dust skirt assembly.
4. Provide a burnisher by one of the following:
   a. Eagle Solutions
   b. Minuteman
   c. Onyx
   d. Pioneer Eclipse
   e. SASE

E. Burnishing Pads:
1. Diamond Impregnated Pads (1500 grit and 3000 grit):
   a. Boride Engineered Abrasives DIP
   b. Scotch-Brite Plus; 3M
   c. Twister; HTC
   d. Trifecta; SASE
   e. Runyon Surface Prep Sofia Pads
2. Natural Hair Pads:
   a. 3M; Niagra Super Hogs Hair Floor Pad 3700N
   b. Norton; Ultra Grizzly Bear
   c. Prosoco; Consolideck Heat Pad
   d. SureShine Heat; SASE
   e. Runyon Surface Prep Hogs Hair pad

F. Applicator Pad
1. 24" High-Performance Damp Microfiber Mop (Blue); Rubbermaid

G. Breathable protective floor cover materials to protect high-traffic areas (do not tape seams).
1. Econo- or Primo- Cover; DRC Industries
2. Ram Board; Ram Board

PART 3 - EXECUTION

3.01 FLOOR JOINT FILLER INSTALLATION

A. General:

1. Installation shall be by a Concrete Polishing Contractor approved in writing by the manufacturer's corporate office for this project.
2. Do not use rigid filler under flooring, carpet, or coatings.
3. Do not use joint filler in coolers or recessed slabs to receive tile.
4. Commence placing floor joint filler by 21 days after the first placement of concrete.
5. If the joint is wet, vacuum it completely and allow it to dry before filling.
6. Install a test sample of the polyurea joint filler and sealant to determine acceptance of dry color.
7. If only burnishing or resin polishing is required, consider using a stain-preventative film to eliminate ghosting or staining from the overage.

B. Cleaning:
1. Immediately before filling, clean and prepare the joint bottom and sidewalls to the full depth of the saw cut, per the manufacturer's recommendation, using the specified preparation saw with vacuum attachments.
2. Remove any residual edge fracturing or spalling created from initial concrete sawing, up to 1/4" in total width. Minimum saw blade width for initial joint filler preparation cut will be 3/16". Joint preparation width must be continuous to the nearest joint intersection or vertical abutment.
3. Remove dirt, debris, saw laitance, and other foreign material from the joint cavity and the top portion of the slab. Clean inner joint walls mechanically using a specified dustless dry-up cut saw to the full depth of saw cuts or two inches minimum depth in construction joints that do not have a sawed bottom shelf ledge.
4. Remove all form release agents, curing compounds, laitance, or other components.

C. Installation:
1. Mix and install joint filler once climatized per the manufacturer's recommendations. Prepare only those that can be installed before the material begins to set.
2. Fill with polyurea joint filler material, preferably in two lifts from the bottom up, taking care not to entrap large air bubbles per the manufacturer's recommendation. Slightly overfill and shave flush to the surface before the polishing process.
3. After grinding, ensure the joint is cut smooth and flush with the finish floor surface without a concave or intermittent darkened profile.
4. Do not allow the filler to extend over joint edges in finished condition.
    a. Do not use joint backup material (i.e., backer rod, sand, etc.) except below the bottom of the saw cut in construction joints. Provide a minimum joint filler depth of 2 inches for backer rod material.
    b. If needed, add extra filler before the filler is set to prevent depressed areas. If the concave filler is already set, remove it to a minimum depth of 3/8" below the surface before refilling.
    c. Razor off crowned filler flush with floor surface after the filler has sufficiently set.

D. Joint refill and repair requirements:
1. At the time of return for final burnishing and enhancement, before turnover, walk the floor with the owner's representative to evaluate, remove, and refill all joints where joint filler:
    a. It has separated from the sidewall or is splitting.

b. The surface profile is concave to a depth greater than 1/16” below the adjacent joint edges, chattered, or has noticeable voids.

2. As stated above, the contractor will require joint refill and repair regardless of the environmental conditions or the time after concrete placement when the joint filler is installed initially.

3.02 EXAMINATION

A. The Polish Contractor is to verify that floor surfaces are acceptable for receiving the work of this section.

B. Verify the Following for New Concrete Floors Finish:
1. Floor Surface Profile: Flatness and Levelness as specified in Section 033100.
2. Concrete Curing: At least 21 days from the last slab placement; fully cured.
3. All exposed concrete slab surfaces to be polished shall have a minimum Mohs’ hardness of 5.5 when measured using the following test method or approved equivalent.
   a. “Deluxe Hardness Picks” manufactured by Mineralab, LLC, (800) 749-3766.
4. Concrete Adjacent to walls, columns, and floor penetrations and at construction joints is troweled flat, with a uniform color and density similar to that of the surrounding concrete.

C. If any surface treatments used are moisture-sensitive, the polishing contractor will be responsible for providing any testing required to ensure compliance with the manufacturer’s requirements for concrete moisture levels during installation.

D. Notify the Architect of conditions that would adversely affect aesthetics or serviceable use of the finished product. Do not begin surface preparation or installation until unacceptable conditions are either corrected or accepted by the Owner’s representative.

E. At locations with differential finishing resulting in a lighter surface appearance, such as columns, sink drains, or construction joints, color correction may be needed. A gray dye should be used in these conditions. Consult with SSI for dilution rates and application techniques.

F. Damage to the floors from construction, such as chips, spalls, scrapes, spills, drilled holes, or needed pour backs, will be repaired by the polishing contractor at the expense of the General Contractor.

3.03 SURFACE PREPARATION

A. Clean concrete surfaces of dirt and other particulates and remove oil, stains, grease, adhesives, water repellents, and other substances that may be detrimental to the work of this Section.
1. All saw-cutting contraction joint dust shall be vacuumed and contained with no residual dust left on the surface.

B. Apply materials per manufacturer's instructions.

C. Protection: Protect surrounding areas and adjacent surfaces from the following:
1. Minimal accumulation of dust from grinding and polishing.
2. Before wet grinding, seal and protect all walls and vertical abutments from water and slurry at least four feet above the finished floor.

3. Prevent contact of overspray of concrete densifier and surface protectant on walls and vertical abutments.

D. Verify that the surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, and residues from cleaning agents and other impediments to adhesion.

E. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

3.04 CONCRETE POLISHING

A. Execute using materials, equipment, and procedures specified by the manufacturer, using a manufacturer-approved installer.

B. Complete all joint filling work, allowing the joint filler to cure within the manufacturer's minimum time requirements before commencing any grinding or polishing. Polyurea joint filling should be concurrent with the grinding and polishing process.

C. Sequential progression shall be required for all grinding, honing, and polishing phases, and the grit value of the previous diamonds used shall be limited to no more than double that.

D. Aggregate Exposure: Fine Aggregate - uniform salt-and-pepper aggregate exposure.
1. Class B, as defined by the Concrete Polishing Council (CPC).
2. Where low areas still have a cream layer, the contractor shall remove the paste layer, exposing the fine aggregates. Aggregate Exposure shall be consistent throughout the Work.
3. Finished floor aesthetics should uniformly match the job site mockup previously approved by the Owner's Representative.

E. Begin wet or dry grinding with the initial grit necessary to produce a uniform refinement, appearance, and pits-free surface without exposing the coarse aggregate.
1. Include all work necessary for proper initial grinding and removals.
2. Overlap adjacent grinding, honing, and polishing passes by a minimum of 40 percent.
3. Between grinding passes and densifier applications, thoroughly scrub and rinse the slab surface with the specified salt and laitance cleaner, mix with clean water, and vacuum up with an auto scrubber.
4. Dispose of waste solution in compliance with all local, state, and federal guidelines and regulations for disposal.
5. Perform each pass perpendicular to the previous.

F. The transitional bonded diamond tooling (just before honing) shall remove all scratches from the initial metal or hybrid grinding steps required to produce a consistent aggregate exposure.

G. If crazing, pits, or divots are observed during the initial grinding process, a specified pit grout coat material shall be used per the manufacturer's recommendations to fill and mask these voids.

H. Progressively hone and polish the slab with 100-, 200-, 400- and polish with 800- and 1,500-, and if needed to meet gloss requirements, use 3000-grit resin-bonded phenolic diamonds.

1. Progressively diamond polish edges along and around all abutments. Use the same progression of polishing diamonds as noted above.
2. Between polishing passes, thoroughly scrub and rinse the slab surface with clean water and vacuum it with an auto scrubber.
3. Perform each pass perpendicular to the previous.

I. Reactive Densifier:
1. Ensure the slab surface is clean and dry at the time of application of the densifier.
2. A minimum of two coats of densifier shall be applied, with the first application installed after 100-grit resins.
3. Apply the second application of densifier after 200-grit resins.

J. Apply two installations of reactive surface densifier per the manufacturer's instructions, ensuring that each application is applied to the point of rejection. Continue progressively polishing with appropriate resin tooling, as stated above.

K. After finishing the last highest grit sequence, burnish the slab surface with a diamond-impregnated pad to remove swirl marks from resin-bonded phenolic diamonds.

L. Surface Protectant(s):
1. Apply two applications of solvent-based penetrating (below) and penetrating surface protectant using previously specified products from the same manufacturer.
2. Apply both protectant products per the manufacturer’s published instructions.
    a. Apply each application using a specified sprayer and tip. Use a new sprayer tip for each night’s work.
    b. Use a new applicator pad for each coat, pre-wetted with protectant, to pull material out and create a thin film before drying.
    c. Burnish after installation of each surface protectant, as defined below.
3. Applying more protectant than the manufacturer’s published instructions may result in additional removal costs to the Contractor without an increase in Contract time. Remove the product from areas of over-application, as evidenced by surface streaking, and replace the protectant.

M. High-Speed Burnish:
1. Burnish after each application of surface protectant, per manufacturer’s instructions, and when the protectant has completely dried.
2. Burnish slowly using a high-speed machine with 1500 or 3000-grit diamond-impregnated or natural hair burnishing pads.
3. Burnish with several passes. Make each progressive pass at 90 degrees from the previous pass.

N. Provide final burnishing and enhancement a maximum of 72 hours before Owner turnover to the owner.
1. Restore all surface aesthetic measurements to specified levels.
2. Repair and re-fill joint materials, as required, at this time.

3.05 FINISH REQUIREMENTS

A. Provide a surface free from scratches and swirl marks with a consistent surface sheen before applying a surface protectant.

3.06 SURFACE AESTHETIC MEASUREMENTShetic Measurements for polished concrete

	Overall Value (OV)	Local Value (LV)
Minimum GLOSS - ASTM D523 (60°)	50	35
Minimum DOI (Distinction of Image) – ASTM D-5757 (20°)	60	40
Maximum Haze – ASTM D4039 (20°)	12	15

Minimum Local Values are the measurement averages within a column bay (area bound by column lines or walls).

3.07 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect the completed polished concrete floor system with the Owner's representative, Contractor, and Installer.

C. The Owner's Representative will validate testing. A test report of all measurements, a plan, and a table of the measurements taken will be prepared for submission.

D. Surface Aesthetic Measurements:
1. It will be validated upon completion of polish work. The contractor shall notify the General Contractor when the floors are ready for testing.
2. The contractor shall furnish and assist in operating the proper meter to measure 60° Specular Gloss, DOI, and Haze following specified ASTM procedures. The General Contractor shall observe and confirm proper random measurements.
3. Measurement and Recording:
    a. Measure surface aesthetic values at three evenly but randomly distributed locations within each column bay within the floor areas to receive a polished finish.
    b. Record all measurements on the slab plan from the contract documents that designate floor joint location (typically S2.0).
4. If overall or local average measured values fail to meet the specified minimums/maximums:
    a. For Gloss or Haze values, additional refinement shall be completed until the specified requirements are achieved.
    b. For DOI values, review procedures with the Owner and Consultant to correct unacceptable areas of the completed polished concrete floor system.

5. The polishing and General Contractor shall furnish a final report of all aesthetic measurements, including sample pictures of actual meter readings and long-view photos of the overall finished floor, completing measurements within 48 hours to the Owner and Consultant. Both parties shall sign this report.
6. These measurements will serve as the baseline for completed work. Any loss of measures aesthetic values greater than 25% below-specified minimums (due to lack of floor protection) that require resin-bonded polishing for remediation at the time of turnover will be the responsibility of the General Contractor.

3.08 NON-POLISHED, EXPOSED CONCRETE SLABS

A. Area to be treated: All exposed interior concrete floors where concrete is not polished.

B. Prepare surface and apply one application of Reactive Densifier to rejection, followed by application of Penetrating Surface Protectant, as specified within and installed per manufacturer’s requirements.

C. The polishing contractor shall have complete access to the areas to be treated during concrete polishing work.

D. Examination and Preparation
1. The application area shall have a minimum cure time of 21 days after concrete placement, before the densifier application, and 10 days before racking installation and other in-store accessories.
2. Examine surfaces receiving densifier. Verify that surfaces conform to the product manufacturer's requirements for substrate conditions.
3. Scrub the floor with specified salt, laitance cleaner, and clean water.
4. Only proceed once all unsatisfactory conditions have been corrected.

E. Application
1. Application shall be performed per manufacturer's published instructions.
2. Employ methods to ensure the concrete surface is not damaged during the application, including discoloration.
3. Apply the densifier to the point of rejection, per the manufacturer’s instructions.

F. Final Surface Condition
1. Verify that water will bead on the slab's surface for two (2) minutes without penetration or discoloration.

G. Disposal
1. Upon completion of each densifier treatment, dispose of excess densifier material as required by the local agency having jurisdiction.
2. Upon completion of work, the certified applicator shall immediately remove all densifier product containers from the job site.

3.09 PROTECTION

A. Continue to protect the completed polished concrete floor system from damage until Substantial Completion per the "Slab Protection Plan" required in Section 033010. This work is the responsibility of the General Contractor.

B. Lift tires should be checked twice daily, and if there are screws in the tires, the screws should be removed immediately to prevent damage to the floor.

3.10 CONCRETE POLISHING SUBMITTAL CHECKLIST

1. Manufacturer's Letter of Contractor Certification for the following:

☐ Joint filler.

☐ Reactive Surface Densifier / Surface Protectant.

☐ Polishing Equipment and Diamond Tooling System(s).

2. Product data and MSDS for the following:

☐ Polyurea joint filler.

☐ Reactive Surface Densifier.

☐ Surface Protectant.

☐ Pit Grout Coat material product for filling pits and voids.

3. Manufacturer and model of all equipment used to complete work, including:

☐ Joint filler prep saw.

☐ Joint filler pumping equipment.

☐ Polishing machines

☐ Dust extraction system.

☐ Diamond tooling.

☐ The diamond tooling manufacturer's grinding guide chart details the appropriate diamond selection for various concrete surface hardness.

☐ Auto Scrubber.

☐ High-speed burnishing equipment

☐ Burnishing pads.

☐ Sprayers and sprayer tips.

END OF SECTION 033543

SECTION 034500
PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete accessories.

B. Grouting under panels.

1.02 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement; Current Edition.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

E. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2025.

I. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

J. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.

K. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete; 2024.

L. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; 2013.

M. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).

N. PCI MNL-122 - Architectural Precast Concrete; 2007.

O. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988.

P. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

1.03 QUALITY ASSURANCE

A. Design Engineer Qualifications: Design precast concrete units under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

B. Design Standards: Comply with ACI 318 and the design recommendations in PCI MNL-120.

C. Quality-Control Standard: Comply with PCI MNL-117 .

D. Fabricator Qualifications:
1. Firm having at least 2 years of documented experience in production of precast concrete of the type required.
2. Plant certified under Precast/Prestressed Concrete Institute Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
3. Fabricator Qualifications: Precast concrete fabricator accredited by IAS according to IAS AC157.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handling: Lift and support precast units only from support points.

B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

D. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.

E. Mark units with date of production in location that will be concealed after installation.

PART 2 PRODUCTS

2.01 PRECAST UNITS, GENERAL

A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI CODE-318.
1. Concrete: Minimum 5000 psi, 28 day strength, air entrained to 5 to 7 percent; comply with ACI 301.
2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
3. Calculate structural properties of units in accordance with ACI CODE-318.

4. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
5. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Deformed billet-steel bars.
   2. Epoxy coated in accordance with ASTM A775/A775M.

B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.

C. Deformed Steel Welded Wire Reinforcement (WWR): ASTM A496.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland Cement - Type I or Type III of same type, brand, and source.

B. Aggregate: Normal-Weight Aggregates: Except as modified by PCI MNL-117, ASTM C33/C33M, with coarse aggregates complying with Class 5S.

C. Grout:
   1. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.04 CONCRETE MIXES

A. Proportion mixes by either laboratory trial batch or field test data methods according to ACI PRC-211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 5000 psi.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.

B. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL-117.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL-117.

2.05 FABRICATION

A. Cast concrete units in size and shape as indicted.

B. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and PCI MNL-117 PCI MNL 117 for fabricating, placing, and supporting reinforcement.

C. Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.

D. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.
   1. After concrete batching, no additional water may be added.

E. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.

F. Maintain plant records and quality control program during production of precast units. Make records available upon request.

G. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.

H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL-117.

I. Maintain consistent quality during manufacture.

J. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

K. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.

L. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
   1. Cure concrete, according to requirements in PCI MNL-117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

M. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

N. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by Architect.

O. Fabricate sill and wall cap in nominal dimensions, allowing for 3/8 inch mortar joints.

2.06 FINISHES

A. Finish exposed surfaces of precast architectural concrete units to a smooth surface finish free of pockets, sand streaks, and honeycombs, with uniform color and texture. Chamfer exposed edges of wall cap and window sill.

2.07 Source Quality Control

A. Provide testing and analysis of concrete mix.

B. Take water absorption test in accordance with PCI MNL-117.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.03 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect units level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

D. Lay units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints. Remove excess mortar.

E. Maintain courses to uniform width. Align vertical joints. Provide joints equal and of uniform thickness.

F. Tool head and bed joints concave. Use tool with large enough radius that joint is not raked free of mortar.

G. Install precast architectural concrete units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL-117, Appendix I.

H. Clean exposed surfaces of precast concrete units after erection to remove markings, dirt, and stains.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135, except as specifically amended below.

END OF SECTION 034500

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SECTION 035400
CAST UNDERLAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Liquid-applied self-leveling floor underlayment.

1.02 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2024.

B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2021.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.05 FIELD CONDITIONS

A. Do not install underlayment until floor penetrations and peripheral work are complete.

B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.

C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cementitious Underlayment:
   1. ARDEX Engineered Cements Ardex K15 Premium Self-Leveling Underlayment with Ardex MC Rapid One Coat Moisture Control System, ARDEX Americas: 400 Ardex Park Drive; Aliquippa PA 15001; Phone: 888-512-7339, www.ardexameric.com.
   2. Mapei Self Leveling Plus Underlayment, MAPEI Corporation: 1144 East Newport Center Drive, Deerfield Beach FL 33442; Phone Tech Support 800-992-6273, Customer Service 800-426-2734, www.mapei.com.

2.02 MATERIALS

A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
   1. Compressive Strength: Minimum 4000 pounds per square inch after 28 days, tested per ASTM C109/C109M.
   2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
   3. Density: 125 pounds per cubic foot, nominal.
   4. Final Set Time: 1-1/2 to 2 hours, maximum.
   5. Thickness: Capable of thicknesses from feather edge to maximum 3-1/2 inch.
   6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.

B. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch in size and acceptable to underlayment manufacturer.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.

D. Primer: Manufacturer's recommended type.

E. Joint and Crack Filler: Latex-based filler, as recommended by manufacturer.

2.03 MIXING

A. Site mix materials in accordance with manufacturer's instructions.

B. Add aggregate for areas where thickness will exceed 1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.

C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.02 PREPARATION

A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.

B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.

C. Vacuum clean surfaces. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

D. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   1. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement or as recommended by the flooring manufacturer.

E. Prime substrate in accordance with manufacturer's instructions. Allow to dry.

F. Close floor openings.

3.03 APPLICATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Pump or pour material onto substrate. Do not retemper or add water.
   1. Pump, move, and screed while the material is still highly flowable.
   2. Be careful not to create cold joints.
   3. Wear spiked shoes while working in the wet material to avoid leaving marks.

C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.

D. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.

E. Place before partition installation.

F. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.

B. Air cure in accordance with manufacturer's instructions.

3.05 PROTECTION

A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.

B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION 035400

SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Mortar and grout.

C. Reinforcement and anchorage.

D. Flashings.

E. Lintels.

F. Accessories.

1.02 SUMMARY

A. This Section specifies the construction of unit masonry assemblies including concrete masonry units (CMU's), mortar, grout, reinforcement, ties, anchors, lintels, control joints, mixing requirements, installation, testing, and finishing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver and install all concrete masonry unit work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to laying masonry units, grout, mortar, reinforcing, accessories and insulation.

C. All work shall be coordinated with other sections. Coordinate delivery with other work to avoid delays.

1.03 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Loose steel lintels.

B. Section 072119 - Foamed-In-Place Insulation.

C. Section 076200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.

D. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.04 REFERENCE STANDARDS

A. ACI 315R-18 - Guide to Presenting Reinforcing Steel Design Details; Current Edition.

B. ACI 530/530.1-13 - Building Code Requirements and Specification for Masonry Structures and Companion Commentaries; Current Edition.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; Current Edition.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

G. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

H. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.

J. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.

K. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.

L. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2025.

M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2025.

N. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.

P. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

Q. ASTM C331/C331M - Standard Specification for Lightweight Aggregates for Concrete Masonry Units; 2023.

R. ASTM C395 - Standard Specification for Chemical-Resistant Resin Mortars; Current Edition.

S. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

T. ASTM C476 - Standard Specification for Grout for Masonry; 2022.

U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

V. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2025a.

W. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.

X. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2019.

Y. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.

Z. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2024.

AA. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2025.

BB. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction; 2012 (Reapproved 2022).

CC. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.

DD. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018, with Editorial Revision (2024).

EE. ASTM D2287 - Standard Classification System and Basis for Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; Current Edition.

FF. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.

GG. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

HH. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

II. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system. Include:
   1. Reinforcing steel.
   2. Detail bending, lap lengths, and placement of unit masonry reinforcing bars.
   3. Contract drawings shall not be reproduced for use as shop drawings.
   4. Comply with ACI 315R-18, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls on drawings.

D. Samples for review in accordance with Sections 013000 and 016000, for each type of masonry unit, mortars, and grouts.

1. Submit mortar and grout mix designs furnished by either the supplier or an independent testing laboratory.
2. Mortar mix design shall designate material quantities as applicable for field mixing.

E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

F. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards.

G. Include material test reports for masonry units substantiating compliance with requirements. Provide mix designs for each type of mortar and grout. Include description of type and proportions of ingredients.

H. Building Square Footage Certification Plan from surveyor shall be submitted by General Contractor prior to erection of walls above floor slab elevation. See Division 1, Section 011000 , Paragraph 1.16 for Area Certification Plan requirements.

I. Substitutions shall be requested in accordance with Sections 012500 and 016000.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Installer Qualifications: It is the intent of this Specification to provide concrete masonry unit work of Standard quality as defined by the NCMA. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

C. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein. Concrete masonry units shall be from a single manufacturer, with uniform texture and color.

D. Certification: Product certificates signed by manufacturer, certifying that materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: Test mortar and grout in the field as follows:
1. Laboratory shall make, cure, break and evaluate test specimens.
2. Specimens for grout shall be made as outlined by governing authorities. Handle specimens for mortar in accordance with procedures outlined by governing authorities.
3. Number of tests will be determined by Architect based on total time for construction of masonry with no less than two (2) tests per week and no less than two (2) tests for each level of masonry construction (foundation to roof or floor.)
   a. Testing shall be in accordance with the requirements of the local jurisdiction.
4. See Division 1 for payment provisions for testing.

G. Tolerances shall conform to ACI 530/530.1-13, except as otherwise noted.

1.07 MOCK-UPs

A. Construct a masonry wall as a mock-up panel sized 8 feet long by 8 feet high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.

1.08 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Locate storage piles, stacks, or bins to avoid or protect material from heavy and unnecessary traffic.

C. Furnish temporary protection for all exposed masonry corners subject to injury.

D. Deliver all insulating materials in original packages, bearing the name of the manufacturer and brand.

E. Store and protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture. Store mortar, grout, and other moisture-sensitive materials off the ground, under cover, and in a dry location.

F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

G. Additional requirements for product delivery, storage and handling are in Section 016000.

1.10 PROJECT CONDITIONS

A. Cold Weather Requirements:
   1. Fully protect all masonry units against freezing by a weathertight covering, which will also prevent accumulation of ice.
      a. Warm units to at least 50 deg F before laying.
      b. When necessary to remove frost or excessive moisture, heat units to a temperature not over 150 deg F.

2. Do not lay masonry when the temperature of the surrounding atmosphere is below 40 deg F in the 24-hour period after laying, unless adequate protection is provided.
   a. Do not use frozen materials or materials containing ice or frost.
   b. Do not build on frozen substrates.
3. Remove and replace masonry units damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
4. Protect all finished work against freezing for a period of not less than 48 hours by means of enclosures, artificial heat or other such protective methods as may be required.
5. Carefully cover tops of walls left incomplete at the conclusion of the day's work with tarpaulins or approved roofers felt, securely held in place.
6. Cold Weather cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
7. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602/ACI 530/530.1-13/ASCE 6.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.02 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 402/602 2/ACI 530/530.1-13/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work[and will be within 20 feet (6 m) vertically and horizontally of a walking surface].

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.03 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:

1. Materials: Concrete masonry units shall be manufactured to meet ASTM C90, Grade N requirements for hollow load bearing concrete masonry units, using medium weight aggregate conforming to ASTM C331/C331M, for either conventional or integral colored units.
2. Load-Bearing Units: ASTM C90, medium weight.
    a. Hollow block, as indicated.
    b. Exposed Faces: Manufacturer's standard color and texture where indicated.
    c. Unit moisture content shall not exceed 30% of total absorption.
    d. Units shall be machine made pre-cast concrete units manufactured in accordance with NCMA Standards.
    e. Units shall have a maximum linear shrinkage not to exceed 0.045 of 1% for a saturated to oven dry condition.
    f. Units to have a value of Minimum Compressive Strength equal to 1900 PSI on net area.
    g. Determine net area compressive strength of masonry by testing masonry prisms according to ASTM C1314.
    h. Sizes of units to be as indicated on the Drawings.
    i. Provide special shapes (such as bull nose, sill units, pilasters, etc.) where required, and as indicated on the Drawings. Special shapes may be required for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
    j. All masonry units shall be a minimum of 45 days old prior to delivery to the job site.
3. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at time of manufacture.
    a. **Provide water repellant approved by Architect on all exposed masonry surfaces that do not receive paint, stucco, or any other overlay.**
    b. Performance of Units with Integral Water Repellent:
        1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            a) No water visible on back of wall above flashing at the end of 24 hours.
            b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            c) No more than 25 percent of wall area above flashing visibly damp at end of test.
        2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
        3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    c. Use only in combination with mortar that also has integral water repellent admixture.
    d. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
    e. Application of the water repellant shall not alter the natural texture of the materials.

2.04 MORTAR AND GROUT MATERIALS

A. All mortar shall conform to ASTM C270, Type S.
   1. Aggregate for mortar shall conform to ASTM C144, except that no less than 3% or more than 10% shall pass a No. 100 sieve.
   2. Admixture for mortar shall be a water reducing plasticizing admixture, stearate type water repellent admixture, introduced at the mixer in a dry powder form.
      a. The material shall give the mortar improved workability, reduce mixing water approximately 20%, a reduction in drying shrinkage, increased bond, reduced permeability, and shall have minimum bleeding.
      b. The material shall be used at the rate of one pint per 100 lbs of portland cement.
      c. The manufacturer, upon request 72 hours in advance, shall make available at no cost, the services of a qualified full-time filed representative to assure proper use of the admixture.
      d. All mortar on the Project shall incorporate the admixture.
   3. Mortar for concrete unit masonry shall be freshly prepared and uniformly mixed in ratio one part portland cement, 1/2 part lime, 3-4 parts sand, and shall conform to ASTM C270, Type S.
   4. Mortar mixing: Add sand, cement and mix, then add lime. Mix mortar after all ingredients are added to mixer for at least five (5) minutes, or until a thoroughly uniform mix is obtained, whichever period is longer. Adjust consistency of mortar to the satisfaction of the mason, adding as much water as is compatible with the convenience in using the mortar. If the mortar begins to stiffen from evaporation of a part of the mixing water, retemper mortar by adding water within basin formed by mortar, and remixing.

B. Mortar coloring material shall consist of limeproof inorganic compounds in the proportions recommended by the manufacturer, but in no case exceeding 15% of the weight of the Portland Cement. At all exposed locations, color mortar to match the color of the masonry units.

C. Cement for mortar and grout shall be Type II, low alkali portland cement conforming to ASTM C150/C150M, standard gray. All cement shall be from one manufacturer.

D. Hydrated Lime: ASTM C207, Type S.

E. Grout Aggregate: ASTM C404.

F. All grout shall conform to ASTM C476, and produce a minimum compressive strength of 2000 PSI at 28 days and determined by the provisions of ASTM C1019.
   1. Materials for grout shall be accurately measured.
      a. When partial batches are mixed, use extreme care in measuring all of the ingredients.
   2. Aggregate for grout shall conform to ASTM D448, coarse aggregate, Size No. 8.
   3. Sand for grout shall conform to ASTM C404, fine aggregate, Size No. 1.
      a. Admixture for grout shall comply with CRD 566-79, Specifications for Grout Fluidifiers. Application rate shall be 1% by weight of all cementitious material in the mix.
   4. Fine grout shall be composed of one part portland cement, to which may be added 1/10 part hydrated lime or lime putty, and 2-1/4 to 3 parts sand.

5. Coarse grout shall be composed of one part portland cement, to which may be added 1/10 part hydrated lime or lime putty, and 2-1/4 to 3 parts sand, and not more than 2 parts aggregate (gravel). This grout may only be used in grout spaces in brick masonry 2” or more in horizontal dimension, and in grout spaces in filled cell construction 4” or more in both horizontal dimensions.
6. Mix grout after all ingredients are added to mixer.
    a. Mix for a period of at least 5 minutes or until a thoroughly uniform mix has been obtained, whichever period is longer.
    b. Grout shall have as high a water content as is consistent with placing and workability without segregation.
7. All grout shall be stirred or mixed at frequent intervals, to prevent separation of the materials.

G. Water: Clean and potable.

H. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units.

I. Accelerating Admixture: Nonchloride, noncorrosive type for use in cold weather, complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Manufacturers:
    a. Addiment Incorporated; Mortar Kick..
    b. Euclid Chemical Company (The); Accelguard 80..
    c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset..
    d. Sonneborn, Div. of ChemRex; Trimix-NCA.

2.05 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
1. ASTM A615/A615M, "Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement," Grade 40 as noted on the drawings only.
2. ASTM A706/A706M, "Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement," weldable rebar.

B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Single Wythe Joint Reinforcement: ASTM A951/A951M and ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
1. Type: Truss or ladder.
2. Reinforcing shall consist of 2 deformed longitudinal side rods with cross rods butt-welded to side rods spaced at 16” intervals.
3. Out to out spacing of side rods shall be approximately 2” less than the nominal thickness of the wall or wythe.
4. Rods shall be not less than No. 9 gauge.

5. Zinc coating shall conform to ASTM A16, Class 1, applied to a weight of not less than 0.4 oz/sq.ft., uncoated wire surface.
6. Furnish joint reinforcement in flat sections 10'-0" to 20'-0" in length.
7. Use prefabricated or job fabricated corner and tee sections to form continuous reinforcement around corners and for anchoring abutting walls and partitions.
8. Re-bar positioners for reinforcing steel shall be AA-239 for vertical steel bars, and AA-238 for horizontal steel bars, as manufactured by AA Wire Products (a division of Hohmann & Bernard of Illinois), Chicago, IL.

D. Masonry reinforcement fabrication tolerances shall be as follows:
   1. Sheared length: Plus 1", Minus 1".
   2. All other bends: Plus 1", Minus 1".

E. Ties and Anchors:
   1. Materials:
      a. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82; with ASTM A153/A153M, Class B-2 coating.
      b. Steel Sheet, galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A153/A153M.
      c. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
   2. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8" (16-mm) cover on outside face. Outer ends of wires are bent 90 deg and extend 2" (50 mm) parallel to face of veneer.
   3. Individual Wire Ties: Rectangular units with closed ends and not less than 4" (100 mm) wide.
      a. Wire: Fabricate from 1/4" (6.4-mm-) diameter, hot-dip galvanized steel wire.
   4. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
      a. Anchor Section for Welding to Steel Frame: Crimped 1/4" (6.4-mm-) diameter, hot-dip galvanized steel wire.
      b. Tie Section: Triangular-shaped wire tie, sized to extend within 1" (25 mm) of masonry face, made from 0.188" (4.8-mm-) diameter, hot-dip galvanized steel wire.
      c. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053" (1.3-mm-) thick, steel sheet, galvanized after fabrication.
   5. Partition Top anchors: 0.097" (2.5-mm-) thick metal plate with 3/8" (10-mm-) diameter metal rod 6" (150 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
   6. Rigid Anchors: Fabricate from steel bars 1-1/2" (38 mm) wide x 1/4" (6.4 mm) thick x 24" (600 mm) long, with ends turned up 2" (50 mm) or with cross pins.
      a. Corrosion Protection: Epoxy coating 0.020" (0.51 mm) thick.

2.06 FLASHINGS

A. Coordinate/Provide installation of flashing and sheet metal materials as required by Section 076200 - Sheet Metal Flashing and Trim, of this Specification, and as indicated on the Drawings, including all labor, materials, equipment, and services necessary to complete the work, and as directed by the Architect.

2.07 ACCESSORIES

A. Preformed Control Joints for 8" and wider walls: Rubber material. Provide with corner and tee accessories, fused joints.
   1. Preformed Control-Joint Gaskets designed to fit standard sash block and to maintain lateral stability in masonry wall. At fire rated walls, provide fire rated joint closures per local codes and Specification Section 079200 herein. Control joints shall be made from one of the following:
      a. Styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805.
      b. PVC, complying with ASTM D2287, Type PVC-65406.
   2. Manufacturers:
      a. Hohmann & Barnard, Inc; RS Series: www.h-b.com/#sle.
      b. Wire Bond; Rubber Control Joint, www.wirebond.com

B. Joint Filler: Closed cell neoprne urethane or polyvinyl chloride; oversized 35 percent to joint width; self expanding; in maximum lengths available.
   1. Premolded filler strips complying with ASTM D1056, Grade 2A1.

C. Building Paper / Bond Breaker Strips: ASTM D226/D226M, Type I ("No.15") asphalt felt.

D. Weeps:
   1. Type: Extruded propylene with honeycomb design.
   2. Manufacturers:
      a. Advanced Building Products, Inc; Mortar Maze weep vent: www.advancedbuildingproducts.com/#sle.
      b. Hohmann & Barnard, Inc; Quadro-Vent: www.h-b.com/#sle.
      c. WIRE-BOND; Cell Vent: www.wirebond.com/#sle.
      d. Heckmann Building Products Inc.; No. 85 Cell Vent.

E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.08 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.09 MASONRY CLEANER

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Do not lay chipped, cracked or otherwise defective units in the wall where exposed to view.

B. Provide proper masonry units for all windows, doors, bond seams, lintels, pilasters, caps, etc., with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular. Do all necessary cutting with a power driven carborundum or diamond disc blade saw.

C. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

E. Lay hollow masonry units with face shell bedding on head and bed joints.

F. Wetting of Brick: Concrete masonry units shall be laid dry. Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

G. Comply with tolerances in ACI 530/530.1-13/ASCE 6/TMS 402/602 2 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8" in 10'-0" (3 mm in 3 m), 1/4" in 20'-0" (6 mm in 6 m), or 1/2" (12 mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8" in 10'-0" (3 mm in 3 m), 1/4" in 20'-0" (6 mm in 6 m), or 1/2" (12 mm) maximum.

H. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

I. Remove excess mortar and mortar smears as work progresses.

J. Interlock intersections and external corners, except for units laid in stack bond.

K. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

L. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

M. Provide all openings in masonry walls where required or as indicated on the Drawings.

N. Build in all items as indicated on the Drawings, identified elsewhere in these Specifications, or as required for a complete job, including but not limited to reinforcing steel, bolts, anchors, nailing block, door and window frames, pipes, conduits and vents.

O. Provide temporary bracing for all masonry walls and leave in place until masonry is cured and the roof diaphragm is secured in place.

P. High lift grout shall be installed in accordance with applicable codes and standards, and as specified below.

Q. Remove and replace any units that are chipped, cracked, broken or otherwise defective, whether before or after setting.

R. Bond Pattern shall be as indicated on the Drawings. Where no bond pattern is indicated, lay up wall in a straight uniform course with regular running bond. Do not use units with less than nominal 4" (100-mm) horizontal face dimensions at corners or jambs. Open ends shall not be exposed.

S. Intersecting block bearing walls shall not be tied together in a masonry bond, except at corners.
   1. One wall shall terminate at the face of the other wall with a control joint at that point.
   2. Tie these walls together with a metal tie bar 1/4” x 1-1/4” x 28” long, with a 2” right angle bend at each end of the bar and spaced vertically 24” on center.
   3. The bends at the ends of the bars to be embedded in cores filled with mortar or concrete.
   4. At exposed locations, rake out these joints 3/4” deep after the mortar has become quite stiff.
   5. Caulking of these joints is specified elsewhere in these specifications.

T. Intersecting non-bearing block walls shall be tied with strips of metal lath or 1/4" mesh galvanized hardware cloth placed across the joint between the two walls.
   1. Place in alternate horizontal block courses.
   2. Rake out and prepare for caulking as specified above.

3.06 LAYING MASONRY WALLS

A. Foundation Preparation:
   1. The foundation on which a reinforced grouted masonry wall will be built must have a clean, smooth surface with aggregate exposed.
   2. Sand blasting may be necessary if the surface has laitance or other foreign material lodged in the pores of the foundation surface.

B. Laying Hollow Cell Masonry Walls:
   1. Provisions as specified under the respective masonry units shall apply to the work specified herein.

C. Masonry units shall be clean and free from dirt when laid in the wall.

D. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

E. Lay all masonry units in uniform and true courses, level and plumb.
   1. Use full mortar bedding for the first course on the foundation and wherever maximum strength is required.
   2. Use face shell bedding except where full mortar bedding is required.
   3. Butter vertical head joints well for a thickness equal to the face shell of the unit and push these joints tight, so that the mortar bonds well to both units.
   4. Solidly fill joints from the face of the unit to the depth of the face shell.
   5. Lay masonry units in the wall to the desired height with joints of uniform thickness.
   6. Lay masonry units in such a way that cracks are not formed at the time the unit is placed in the wall.
   7. Level, plumb, and straighten before mortar stiffens.
      a. Adjust masonry units to their final position in the wall while the mortar is still soft and plastic enough to ensure a good bond.
      b. If the position of the unit is shifted after the mortar has stiffened, or bond is broken, or cracks are formed, relay unit in new mortar.

8. Bond shall be plumb throughout.

F. Grout hollow masonry units, as shown on the drawings, below all steel bearing plates, beams bearing on masonry walls, or as otherwise required to carry loads onto masonry walls.

G. Provide solid grout between webs of masonry face shells for full length of all steel lintels. Lay face units, soaps, romans, etc., with full head and bed joints.

H. Protect masonry against too rapid drying by hosing down thoroughly twice each day for five (5) days, including Saturday and Sunday, following laying of units. Hosing once each day is sufficient where the high temperature for the day does not exceed 80 deg F, or where masonry is shaded from direct sunlight.

I. Where masonry is scheduled to receive damp proofing, provide parge coat of mortar over all masonry surfaces. At all inside corners, parge to form cove.

J. Solid grout all metal door frames in masonry walls as each 2'-0" of masonry is laid.

K. Where masonry is to enclose conduit or piping, bring it to proper level indicated, and as approved by the Architect. Do not cover any pipe, conduit chases, or enclosures until advised that work has been inspected and tested. Build in items specified in this and other Sections of this Specification.

L. Cold weather requirements: When air temperature is below 40 deg F, provide adequate equipment for heating the mortar and grout materials. Temperatures of separate materials, including water, shall not exceed 140 deg F, when placed in the mixer. Maintain mortar and grout between 50 deg F, and 90 deg F while being used.

M. Hot weather requirements: Wet mortar board before loading and cover mortar to retard drying when not being used.
1. Use all mortar and grout within one hour of initial mixing and use no mortar or grout after it has begun to set up or after it has become harsh or non-plastic.

N. Fill cores in hollow concrete masonry units with grout 24" (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.07 WEEPS/CAVITY VENTS

A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels.

B. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products or open head joints to form weep holes.
2. Space weep holes 24" (600 mm) o.c., unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

C. Install vents in head joints in exterior wythes at spacing indicated. Use open head joints to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.08 MORTAR BEDDING AND JOINTING

A. Mortar joints shall be straight, clean, and uniform in thickness.

B. Where masonry units are to receive stucco, plaster, wallboard, or other covering, strike joints flush.

C. At exposed areas, joints shall be concave tooled as indicated on the Drawings.

D. Unless otherwise indicated or specified, horizontal and vertical mortar joints shall be a nominal 1/3” thick, and course vertically to 4” or 8”, horizontally to 16”.

3.09 REINFORCEMENT AND ANCHORAGE - GENERAL and SINGLE WYTHE MASONRY

A. Place horizontal reinforcing in first and second bed joints above and below opening, and every 16” vertically throughout remainder of structure.
1. Continuously reinforce first bed joint immediately above and below openings.
2. In second bed joint, it shall extend 2'-0" beyond each side of opening.
3. Lap reinforcement a minimum of 6” at splices and cut and bend at corners.

B. Place vertical reinforcing and bond beam reinforcing as indicated.
1. Lap splices in reinforcing as shown in the structural drawings.
2. Use re-bar positioners to position reinforcing steel in cells and at all laps in steel bars.
3. Reinforce all walls vertically as indicated on the Drawings.
4. Provide vertical reinforcement at all wall ends, corners, intersections and at jambs of openings.
5. Provide all reinforced bond beams indicated.
6. Grout barrier below bond beams shall be continuous wire lath.

C. Space vertical reinforcing in center of grout at center of wall, continuous full height of wall with one #5 at all corners, intersections, wall ends, jambs, at each side of control joints, and at the intervals specified on the drawings.
1. Dowel all vertical reinforcing to foundation with dowels to match vertical wall or column reinforcing.

D. Reinforcing steel shall be in place and inspected prior to grouting.
1. Vertical cells to be filled shall have vertical alignment to maintain a continuous cell area.
2. Fill cells solidly with grout in lifts not to exceed 5'-0" and stop pours 1-1/2” below the top of a course to form a key at pour points.
3. Rod grout in vertical spaces immediately after pouring, and again about 5 minutes later.
4. Grout beams over openings and bond beams in a continuous operation.
5. Solidly grout in place all bolts, anchors, etc. See this section for high-lift grout requirements.

E. Install in mortar with a minimum cover of 5/8" (16 mm) on exterior side of walls, 1/2" (13 mm) elsewhere.

F. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

G. Provide continuity at wall intersections by using prefabricated T-shaped units.

H. Provide continuity at corners by using prefabricated L-shaped units.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

C. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

D. Install flashing as follows, unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.
   2. At lintels and shelf angles, extend flashing a minimum of 6" (150 mm) into masonry at each end. At heads and sills, extend flashing 6" (150 mm) at ends and turn up not less than 2" (50 mm) to form end dams.
   3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2" (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
   4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2" (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

3.11 LINTELS

A. Install loose steel lintels over openings as indicated on the Drawings. Size as indicated on the Drawings. Minimum bearing of 6" at each end.

B. Weld reinforcing bars to lintel. Stitch weld angles back to back.

3.12 GROUTED COMPONENTS

A. Grout shall be installed in accordance with applicable codes and standards, as indicated on the Drawings, and as specified herein.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. Comply with requirements of ACI 530/530.1-13 for cleanouts and for grout placement.

F. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

G. Grout locations and maximum pour heights are as indicated on the Drawings and specified herein.

H. The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.

I. Pour no grout unless the masonry wall has been allowed to cure a minimum of three (3) days in hot weather and five (5) days in cold damp weather.
   1. Grout may be placed by hand bucket, concrete hopper or through a grout pump.
   2. Grout space shall not be wet down prior to placing of grout.
   3. Align cells to be grouted to form unobstructed, continuous vertical spaces within the wall.
   4. Mortar the webs around the cores of all cells to be grouted.
   5. Keep excess mortar from extruding and falling into the grout space. Remove mortar that projects more than 3/8" into the grout space.
   6. At the foundation, mortar bedding under the first course to be grouted shall be such as to permit grout to come into direct contact with the foundation or bearing surface.

J. A grout pour may consist of one or more grout lifts.
   1. All cells and spaces containing reinforcing bars shall be filled with grout. Grout shall be placed so that spaces to be grouted do not contain voids.
   2. Place grout in lifts not exceeding 5'-0" in height.
   3. Use a 3/4" flexible cable vibrator for consolidation of each grout lift immediately after placing.
   4. Between grout pours, a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with the grout stopping a minimum of 1-1/2" below a mortar joint, except at the top of the wall.
   5. Where bond beams occur, the grout pour shall be stopped a minimum of 1/2" below the top of the masonry.
   6. Where grout pour height exceeds 5 feet, cleanouts shall be provided in the bottom course at every vertical bar location but shall not be spaced more than 32 inches on center for solid grouted masonry. Grout shall be placed in grout lifts not to exceed 5 feet. Following water loss absorb by masonry units, a subsequent lift may be placed. Grout pour heights shall not exceed 16 feet.
   7. Reinforcing shall be continuous the full height of the grout pour plus any required lap above. Reinforcement shall be secured against displacement prior to grouting by wire positioners or the suitable devices at intervals not to exceed 200 bar diameter nor 10 feet.

K. Use extreme care to prevent any grout or mortar from staining the face of the masonry to be left exposed or painted.
   1. Grout or mortar which is visible on the face of such masonry shall be immediately removed.
   2. Protect all sills, ledges, offsets, and other projections, from droppings of mortar or grout, and protect door jambs and corners from damage during construction.

3.13 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Provide control joints, as indicated on the Drawings and as required by the applicable codes, at all vertical masonry walls where such walls exceed 40'-0" in length.
   1. In long length of walls, provide joints at a maximum of 30’-0”o.c. or as indicated.
   2. Do not locate less than 24” from a bearing plate or from a jamb of an opening wider than 48”.
   3. Control joints shall be continuous full height of walls.
   4. At bond beams, control joint shall separate both block and grout. However, steel reinforcing shall be continuous.
   5. Hold control joint fill materials back from finished surfaces.
   6. Where applicable, at fire rated walls, provide fire rated joint closures in accordance with local codes and Division 7.

3.14 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
   1. Provide an open space not less than 1" (25 mm) in width between masonry and structural member, unless otherwise indicated.
   2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24" (610 mm) o.c. vertically and 36" (915 mm) o.c. horizontally.

3.15 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners.
   2. Embed tie sections connector sections and continuous wire in masonry joints. Provide not less than 1" (50 mm) of air space between back of masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16" (406 mm) o.c. vertically and 32" (813 mm) o.c. horizontally with not less than 1 anchor for each 3'-6" SF (0.33 sq. m) (0.25 sq. m) of wall area. Install additional anchors within 12" (305 mm) of openings and at intervals, not exceeding 36" (914 mm), around perimeter.

3.16 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

3.17 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

C. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

3.18 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction

B. Placing Reinforcement: Comply with requirements in ACI 530.1.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530/530.1-13 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60".

3.19 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
   1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports, all reports shall be provided to the Architect:
   1. Testing Frequency: One set of tests for each 5,000 SF (465 sq. m) of wall area or portion thereof.
   2. Clay Masonry Unit Test: For each type of unit provided, per ASTM C67/C67M.
   3. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C140/C140M.
   4. Mortar Test (Property Specification): For each mix provided, per ASTM C780. Test mortar for mortar air content and compressive strength.
   5. Grout Test (Compressive Strength): For each mix provided, per ASTM C1019.

3.20 POINTING AND CLEANING

A. Clean soiled surfaces with cleaning solution.

B. Point and fill holes and cracks in exposed mortar joints.
   1. Cut out defective mortar joints, refill solidly with mortar, and tool as indicated on the Drawings and in the Specification herein.
      a. Pre-hydrate mortar for pointing by mixing dry ingredients with only sufficient water to produce a damp mass of such consistency that it will retain its form when pressed into a ball with the hands but will not flow under the trowel.
      b. Allow mortar to stand for a period of not less than one hour, and not more than two (2) hours, after which, remix with the addition of sufficient water to produce satisfactory workability.

C. Pointing mortars shall be identical to adjacent mortar in similar joints, and finish results shall match and be indistinguishable from original mortar used.

D. Upon completion of the masonry work, clean all exposed masonry in an approved manner acceptable to the Architect.

E. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

F. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
   2. Protect adjacent surfaces from contact with cleaner.
   3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.21 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.22 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
   3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 047300
MANUFACTURED STONE MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered manufactured stone masonry veneer (AMSMV).

B. Installation materials.

C. Accessories.

1.02 SUMMARY

A. All labor, materials, equipment, and services necessary to furnish and install all adhered manufactured stone masonry veneer work as indicated or specified for exterior application.

1.03 REFERENCE STANDARDS

A. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

B. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

D. ASTM C192/C192M - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory; 2019.

E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

F. ASTM C482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste; 2020.

G. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.

H. ASTM C847 - Standard Specification for Metal Lath; 2018 (Reapproved 2024).

I. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2024.

J. ASTM C1670/C1670M - Standard Specification for Adhered Manufactured Stone Masonry Veneer Units; 2021b.

K. ASTM C1780 - Standard Practice for Installation Methods for Cement-Cased Adhered Masonry Veneer; 2020.

L. ICC-ES AC51 - Acceptance Criteria for Adhered Manufactured Stone Masonry Veneer; 2018, with Editorial Revision (2021).

M. NCMA (AMSV) - Installation Guide and Detailing Options for Compliance with ASTM C1780 for Adhered Manufactured Stone Veneer; Current Edition, Including All Revisions.

N. NCMA TEK 20-01 - Key Installation Checkpoints for Manufactured Stone Veneer; 2014.

O. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project with five years minimum experience.

B. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, and approving application method.

C. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.

D. Manufacturer’s Instructions: Install per manufacturer’s installation instructions.

1.05 MOCK-UPS

A. Construct mock-up panel 8 feet long by 6 feet high; include AMSMV, lightweight synthetic stone veneer, mortar, accessories, substrate, representative wall openings, and sills.

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Prevent mechanical damage and contamination by other materials.

C. Protect products from precipitation combined with freezing temperatures. Do not install products with visible frozen moisture.

D. Allow no construction activity on opposite side of wall during installation, and for 48 hrs after completion of work.

1.07 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Adhered Manufactured Stone Masonry Veneer (AMSMV):
1. Coronado Stone Products; Old Monarch: Phone: (864) 962-1221. www.coronado.com/#sle.
2. Substitutions: Not permitted.

2.02 ADHERED MANUFACTURED STONE MASONRY VENEER (AMSMV)

A. AMSMV: Cast masonry units using a mixture of cement, lightweight aggregates, concrete additives and color pigments to replicate appearance of natural stone and designed to be applied with a cementitious mortar to a backing surface, complying with ASTM C1670/C1670M and ICC-ES AC51.
1. Profile: As per AMSMV. Include matching corner pieces.
2. Stone Dimensions (approximate): As per AMSMV.
3. Alternate AMSMV: Slate Rustic Gold Collection (Ledgestone) Natural Stone Slate Wall Tile. (Submit to Architect of Record for approval)
4. Color, Texture, Range, Special Shapes: As indicated on drawings.

B. Product Characteristics:
1. Unit Weight: 15 lb./sq ft., saturated.
2. Compressive Strength: ASTM C192/C192M and ASTM C39/C39M, 5 sample average greater than 1,800 psi.
3. Shear Bond Strength: 50 psi minimum, in accordance with ASTM C482 using a unit thickness approximately the same as the stone unit.
4. Thermal Resistance: 0.355 at 1.0 inches thick, in accordance with ASTM C177.
5. Freeze-Thaw Test: ASTM C67/C67M, less than 3 percent weight loss and no disintegration.
6. Fire Hazard Test on 1-7/8" Thick Sample: Flame spread of 25, smoke development of 450 in accordance with UL 723.

7. Corner Stones: “Wrap-around” type with no cut or corner “butted” stones.

2.03 MORTAR APPLICATIONS

A. Use only factory premixed packaged dry materials for mortar, with addition of water only at project site.

B. Manufactured Veneer Installation System (MVIS):
1. Manufacturer.
   a. Laticrete International, Inc., 1 Laticrete Park North, Bethany, CT 06524-3423 USA Phone 800-243-4788, (203) 393-0010 technicalservices@laticrete.com , www.laticrete.com .
2. Mortar Air and Water Barrier: Waterproofing
   a. MVIS Air and Water Barrier.
3. Mortar Scratch Coat:
   a. MVIS Premium Mortar Bed.
4. Mortar Brown Coat:
   a. MVIS Veneer Mortar.
5. Pointing Mortar:
   a. MVIS Premium Pointing Mortar.
   b. Color: As Selected by Architect from Manufacturer’s full range of colors.
6. Sealant:
   a. MVIS Silicone Sealant.
   b. Color: As Selected by Architect.

2.04 MORTAR MIXES

A. Mixing: Mix proprietary materials in accordance with manufacturer’s instructions, including product data and product technical bulletins.

B. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270, Type N. Do not use anti-freeze compounds to lower the freezing point of mortar.

2.05 ACCESSORIES

A. Metal Lath with Rainscreen Drainage Material: Factory-assembled combination of mesh drainage material and metal lath.
1. Diamond Mesh Metal Lath: ASTM C847, galvanized, self-furring.
   a. Weight: To suit application and as specified in ASTM C841 for framing spacing.
   b. Location: Provide at all framed wall conditions. (Not required at masonry walls)

B. Sill Trim:
1. 900 Series Sill by Coronado Stone Products.
2. Color: #2 Gray.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that backup wall system construction complies with AMSMV manufacturer's instructions, NCMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51.

B. Verify that substrates to receive mortar scratch coat or setting bed comply with AMSMV manufacturer's instructions, NCMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51:
   1. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

C. Verify that related items provided under other sections are properly sized and located.

D. Verify that built-in items are in proper location, and ready for installation of AMSMV.

3.02 PREPARATION

A. Dampen masonry surfaces to reduce excessive suction.

B. Clean concrete surfaces of foreign matter using approved acid solutions, solvents, or detergents, and then rinse surfaces thoroughly with clean water.

C. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.

3.03 INSTALLATION - AIR AND WATER-RESISTIVE BARRIER

A. Install the vapor permeable air and water barrier in compliance with current revisions of manufacturer’s written installation instructions. Review the installation and plan the application sequence. Pre-cut Laticrete Waterproofing/Anti-Fracture Fabric (if required), allowing 2” (50mm) for overlap at ends and sides to fit the areas as required. Roll up the pieces for easy handling and placement. Shake or stir Laticrete MVIS Air & Water Barrier before using.

B. Install sheathing panels and treat joints in accordance with the respective sheathing panel manufacturer’s installation instructions, including installation of board joint treatment. Pack any gaps around pipes, lights or other penetrations with LATAPOXY Waterproof Flashing Mortar and allow to harden.

C. Treat substrate joints and seams up to 1/8” (3 mm) by applying a liberal coat of Laticrete MVIS Air & Water Barrier approximately 8” (200 mm) wide over seam using a paint roller (heavy napped), brush or trowel. While Laticrete MVIS™ Air & Water Barrier is still wet embed 6” (150 mm) wide Laticrete Waterproofing/Anti-Fracture Fabric pressing the fabric in firmly so that the Laticrete MVIS Air & Water Barrier liquid bleeds through the fabric, then immediately apply another liberal coat of Laticrete MVIS Air & Water Barrier liquid over the fabric using a paint roller, brush or trowel.

D. For substrate joints and seams greater than 1/8” (3 mm); fill seams to a smooth finish with a Laticrete Polymer Fortified Veneer Mortar. Allow mortar to set 24 hours, then treat seams by applying a liberal coat of Laticrete MVIS Air & Water Barrier approximately 8” (200 mm) wide over seam. While Laticrete MVIS Air & Water Barrier is still wet embed 6” (150mm) wide Laticrete Waterproofing/Anti-Fracture Fabric pressing the fabric in firmly so that the Laticrete MVIS Air & Water Barrier liquid bleeds through the fabric, then immediately apply another liberal coat of Laticrete MVIS Air & Water Barrier liquid over the fabric. Laticrete MVIS Air & Water Barrier will dry to a uniform olive green color when it’s dry to touch.

E. Check application thickness with a wet film gauge periodically as the Laticrete MVIS Air & Water Barrier is being applied to ensure that the appropriate thickness and coverage is achieved. Bounce back and overspray will consume more product. To achieve the required film thickness, the coating must be free from pinholes and air bubbles. Bring main application of Laticrete Air and Water Barrier up to all penetrations through the membrane. Do not back roll the spray applied coating. Allow the Laticrete MVIS Air & Water Barrier to cure in accordance with the instructions in this document and TDS 410M prior to the installation of finish materials. It is important to note that areas not scheduled to receive the Laticrete MVIS Air & Water Barrier should be taped off and protected from any potential overspray.

3.04 INSTALLATION - SCRATCH COAT

A. Apply mortar scratch coat of 1/2 inch nominal to cover metal lath in accordance with ASTM C926. Scratch surface when somewhat firm. If scratch coat dries before applying setting bed mortar and AMSMV, moisten scratch coat by misting it with water.

B. Spread the mortar over clean, dimensionally stable and sound substrates, apply latex-portland cement thick-bed mortar as scratch/leveling coat in compliance with current edition of CHMA / National Concrete Masonry Association (NCMA) “Installation Guide and Detailing Options for Compliance with ASTM C1780 for Adhered Manufactured Stone Veneer” and / or veneer manufacturer’s specific written installation instructions. Float surface of scratch/leveling coat plumb, true and allow mortar to set until firm. At locations indicated, apply mortar scratch coat of 1/2 inch (12.5 mm) nominal to cover metal lath in accordance with ASTM C926. Scratch surface when somewhat firm. If scratch coat dries before applying setting bed mortar and veneer, moisten scratch coat by misting it with water.

3.05 INSTALLATION - AMSMV

A. Installation of AMSMC to be in compliance with current edition of CHMA / National Concrete Masonry Association (NCMA) “Installation Guide and Detailing Options for Compliance with ASTM C1780 for Adhered Manufactured Stone Veneer” and / or veneer manufacturer’s specific written installation instructions.

B. Install AMSMV with a cementitious mortar setting bed to a scratch coat backing surface, in accordance with AMSMV manufacturer's instructions, NCMA (AMSV), NCMA TEK 20-01, ASTM C1780 and ICC-ES AC51.

C. Sills: Install sills where located on drawings.

D. When installing stones, apply a 1/2" thick layer of mortar on the back of the stones. Apply any corner stones first by interchanging the long direction of the stones. Work each stone back and forth into wall, watching for a small amount of mortar to squeeze out around the stone.

E. Allow no more than a 1/2" gap between adjacent stones. Stone types can be started from the top down. It may be necessary to start at the bottom if using a tight fit method when applying rectangular stone types. Keep the joints level.

F. If stone is being applied in hot or dry weather, the back of each piece should be moistened with a fine spray of water or a wet brush to adequately prevent excessive absorption of moisture from the mortar. If being installed over concrete, masonry or scratch coat substrate, the substrate surface area should also be dampened before applying mortar. Applications should be protected from freezing, as mortar will not set up properly under such conditions. Do not use antifreeze compounds to lower the freezing point of mortar.

G. Mortar: Apply 1/2” to 3/4” of mortar to dampened masonry surfaces, covering a maximum of 10 sq ft at one time. Press the units firmly into position in soft mortar bed, wiggle and apply slight pressure to unit to ensure firm bonding causing mortar to extrude slightly around edges of units. Ensure complete coverage between the mortar bed and back surface of the stone. Mortar may also be applied to the entire back of the stone. Mortar must fill all voids along each stone’s edges. Rake out excess mortar.

H. Cutting: Perform necessary cutting with proper tools to provide uniform edges, take care to prevent breaking unit corners or edges. Cut and fit pipes and conduit. Coordinate with other sections to provide correct size, shape, and location.

3.06 INSTALLATION - MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Extend metal flashings through exterior face of AMSMV and terminate in an angled drip with hemmed edge.

C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.07 CONTROL AND EXPANSION JOINTS

A. Form joints as detailed on drawings.

3.08 TOLERANCES

A. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

3.09 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove construction debris from project site and legally dispose of debris.

B. Remove excess mortar and mortar smears as work progresses.
   1. Clean excess mortar/epoxy from veneer surfaces with water before they harden and as work progresses. Do not contaminate open grout/caulk joints while cleaning. Sponge and wash veneers diagonally across joints. Do not use acids for cleaning. Polish with clean dry cloth.
   2. Use a strong solution of granulated soap or detergent and water with a bristle brush. Do not use a wire brush as it will cause damage to the surface. Rinse immediately with fresh water. Do not attempt to clean using acid or acid based products. Do not clean with high pressure power washer.

C. Replace defective mortar. Match adjacent work.

D. Clean AMSMV in accordance with manufacturer's installation instructions.

E. Clean soiled surfaces with cleaning solution.

F. Salt and De-icing Chemicals: Do not use de-icing chemicals on areas immediately adjacent to a Cultured Stone application.

G. Scuffing: Remove scuffmarks by cleaning as specified herein.

H. Efflorescence: To remove efflorescence, allow stone to dry thoroughly, and then scrub vigorously with a stiff bristle brush and clean water.

I. Rinse thoroughly. Do not use a wire brush. For difficult efflorescence problems, scrub thoroughly with a solution of 1 part white household vinegar to 5 parts water. Rinse thoroughly.

J. Remove surplus materials and leave premises broom clean.

K. Use non-metallic tools in cleaning operations.

3.10 PROTECTION

A. Protect finished work from rain during and for 48 hours following installation.

B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

C. Sealer: Apply per manufacturer's written instructions.

END OF SECTION 047300

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SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Grouting under base plates.

1.02 GENERAL

A. This Section specifies the construction of all structural metal framing, including columns, beams, lintels attached to steel columns, lintels over 200 lbs in weight, masonry bearing plates, connectors, shelf angles, primer, and grout.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all structural metal framing work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to fabricating, delivering, and erecting structural metal framing, cutting, fitting, welding, cleaning, painting, providing temporary supports, and removing all temporary steel elements necessary for erection of structural metal.

C. Coordinate delivery with other sections herein and other work to avoid delay.

1.03 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.04 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2023, with Errata (2025).

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022, with Errata (2025).

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

F. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.

G. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

I. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.

J. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2024.

K. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2023.

L. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.

M. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2024.

N. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

P. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

R. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.

S. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings:
1. For structural metal framing: Base drawings on Construction Documents, and details.
2. Shop drawings shall clearly show plans, elevations, sections, details, and attachments to other work, location, fastening and anchorage details, and materials required.
3. Submit complete shop fabrication details and erection diagrams. Such shop details and erection diagrams shall give all pertinent information of construction methods proposed, together with all required dimensions for the proper fitting for the connection with other work and materials.
4. Show, in detail, fabrication of all structural metal components included in the Contract.

5. Contract drawings shall not be reproduced for use as shop drawings.

D. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material test reports, substantiating compliance with requirements.

E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

G. Designer's Qualification Statement.

H. Fabricator's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
1. Welding: Qualified procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code”.

C. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein, including but not limited to:
1. American Institute of Steel Construction
   a. Specifications for the Design, Fabrication and Erection of Steel for Buildings.
   b. Code of Standard Practice
   c. Manual of Steel Construction
2. American Welding Society: Code for Welding in Building Construction AWS D1.0.
3. Latest edition of each of above governing standards shall apply.
4. Fabricate in accordance with the AISC Quality Certification Program

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: As required by the latest industry codes and standards.
1. Field tests: Where a welded splice is fabricated in beams or columns, other than those detailed, the fabricator shall have the splice connection tested using one of the following methods:
   a. magnetic particle
   b. radiographic
   c. ultrasonic

2. The testing shall be conducted by an independent testing laboratory and a report submitted to the Architect and Owner Representative.
3. The costs of this testing shall be borne by the fabricator.

G. Performance requirements:
1. Provide assemblies capable of withstanding design loads within limits and under conditions indicated on the Drawings.
2. Select and complete connections using schematic details indicated, and AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Volume 2, Part 9.
3. Any engineering design provided by others and submitted for review shall bear the seal of a civil or structural engineer registered in the state in which the project is located.

H. Tolerances shall conform to industry codes and standards, except as otherwise noted.

I. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
1. Make welds by the electric-arc process.
2. Grind all exposed welds smooth.
3. Where weld size is not indicated, it shall develop full strength of member and connection.

1.07 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.08 DELIVERY, STORAGE AND HANDLING

A. Store all steel materials off the ground and protect materials from corrosion and deterioration. Store fasteners in a protected location. Clean and lubricate bolts and nuts that become dry or rusty before use.

B. Protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture. Store materials off the ground, under cover, and in a dry location.

C. Additional requirements for product delivery, storage and handling are in Section 016000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural steel shapes, plates and bars shall conform to ASTM A36 (Fy = 36,000 PSI), except A992 ' W' shapes (Fy=50,000 PSI).

B. Steel pipe columns shall conform to ASTM A53/A53M, Grade B.

C. Steel Angles and Plates: ASTM A36/A36M.

D. Steel W Shapes and Tees: ASTM A992/A992M., Grade 50.

E. Channels, M, S-Shapes: ASTM A36/A36M.

F. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.

G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

H. Expansion bolts shall be Simpson Strong Bolt 2 wedge Anchor installed in accordance with ICC ESR - 3037, unless noted otherwise.

I. Headed Anchor Rods: ASTM F1554 Grade 36, plain.
   1. Anchor bolts and nuts and machine bolts shall conform to ASTM A307, unless otherwise indicated.

J. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

K. Welding rods shall conform to AWS A5.0, E70 series, low hydrogen type.

L. Sections shall be of dimensions, weight and design as indicated, assembled complete at the shop, with base plates and other detailed materials attached. Furnish 1/4" thick leveling plates at all columns where base plates are shop fabricated to columns.

M. All material must be new, of uniform quality, suitable and without defects affecting the strength of service of the structure.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. All structural steel shall be fabricated by an AISC certified fabricator. Qualification shall be in effect at time of bid.

C. All workmanship, details of construction, etc., except as otherwise indicated or specified, shall conform with AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings", AISC "Code of Standard Practice", and applicable building codes.

D. Shop fabricate and assemble steel to the greatest extent possible prior to delivery to site.

E. Make connections as indicated or detailed, on the Drawings, and the approved shop and erection drawings.

F. Mark materials for field assembly. Arrange fabrication order for most efficient delivery sequence for field assembly.

G. All exposed steel shall have smooth, clean surfaces with no identifying trademarks, names, etc., exposed to view.
   1. Leave in condition for finish painting.

H. Machine bolts shall have proper length shanks with no bearing on threaded portions.

I. Erect all work to the proper lines and levels, plumb and true, and in correct relation to other work.
   1. Secure all parts in a rigid and substantial manner during construction.

J. Bolted connections shall be as detailed or shall conform to AISC standard bolted connections with maximum number of 3/4" diameter ASTM A325 N. bolts. Use Snug Tight.
   1. See Framed Beam Connections Table I, II, III, or IV of AISC Manual of Steel Construction.

K. No slotted holes permitted at steel connections unless approved by Architect.

L. Where bolt holes in steel members are enlarged to more than 1/16" diameter oversize, provide 3/16" x 2-1/2" x 2-1/2" plate washers with proper diameter hole.
   1. Weld plate washers to steel members with 1/8" fillet weld all around.

M. Structural Steel: Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design, or Load and Resistance Factor Design Specification for Structural Steel Buildings", as required.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

C. All metals shall be shop primed per ASTM standards unless indicated otherwise.

D. Metal primer shall conform to FS TT-P-636.

2.04 PAINTING - SHOP COAT

A. Clean all steel work by wire brushing, or by other means selected by the fabricator, of loose mill scale, loose rust, accessible weld slag or, flux deposit, dirt and other foreign matter.
   1. Remove oil and grease deposits by solvent.

B. After cleaning, give all steel work one coat of metal primer.

1. Apply primer thoroughly and evenly to dry surfaces, by brush, spray, roller coating, flow coating or dipping at the selection of the fabricator.
2. Apply primer at a rate of 350 SF per gallon to provide a wet film of 4.5 mils.

C. Paint erection marks on painted surfaces.

D. Touch-up all surfaces where welding, grinding of welds, joints, etc., are done in the field.

E. Paint shall be thoroughly dry before the members are handled or loaded.

2.05 SOURCE QUALITY CONTROL

A. Provide shop testing and analysis of structural steel.

B. Comply with testing and inspection requirements of Part 3, Article "Field Quality Control."

C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

B. Verify all anchor bolt locations, grouting and elevation of base and setting plates and other material set by other trades, etc., before commencing work.

C. Notify the Architect of any work set by others if out of tolerances specified, and do not erect any material upon such work until it has been corrected satisfactorily.

D. Starting work implies acceptance of the work of other trades affecting erection of the structural frame.

E. Final results are the entire responsibility of the Contractor.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of Architect and Structural Engineer.

D. Erect material plumb and level and maintain this condition to completion.

E. Connect members temporarily and align completely before making permanent connections.

F. Temporary conditions shall consist of bolts in no less than one-third of the holes and in no case less than 3 bolts in any single connection.

G. Surfaces in contact shall be thoroughly clean when assembled.

H. Provide necessary temporary bracing and guying to align the structure properly for permanent connections, and safely resist all erection, dead load and wind stress.

I. Take particular care to have the work plumb and level (maximum tolerance 1 to 500 for interior members, 1 to 1000 for exterior members) before making permanent connections.
   1. Remove bracing and guys only after permanent alignment, and assembly and structure is capable of completely sustaining design and temporary construction loads.

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

K. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges", and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design, and Load and Resistance Factor Design Specification for Structural Steel Buildings" as applicable.

L. Base and Bearing Plates: Clean concrete and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
   1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of base plate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surface. Protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

M. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.
   1. Nonmetallic, Shrinkage-Resistant Grout: Factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, of consistency suitable for application, and 30 min working time. Minimum compressive strength shall be 5000 psi at 28 days when tested in accordance with ASTM C1107/C1107M.

3.03 TOLERANCES

A. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.04 CONNECTIONS

A. Machine Bolting:
   1. Fair-up holes with pins to align holes before bolting.
   2. Ream unfair holes to obtain alignment or drill new holes.
   3. Enlargement of holes with drift pins or burning of new holes is not permitted.
   4. Draw bolts up tight after members are aligned and leveled and set or deform threads to prevent loosening.

B. Welding:
   1. Weld by shielded arc method per AWS standard code for arc and gas welding in building construction.
   2. Submit certification that welders have passed AWS code qualification tests.
   3. Certification must be dated no earlier than three (3) months prior to beginning of project.
   4. Refer to shop drawings for weld size and dimensions.
   5. Close all joints exposed to weathering with continuous 1/8" weather welds.
   6. Grind smooth all exposed welds, but grinding shall not reduce weld strength or required cross section.
   7. Protect all finish material from damage due to welding.
   8. Remove unsatisfactory welds by chipping or arc air method.

C. Field Painting:
   1. Spot paint all abrasions, field bolts and field welds with same paint used for shop coat.
   2. Remove all temporary guys, bracing and bracing clips and grind flush all burrs remaining, before painting.
   3. Remove all welding slag, spatter, rust and burnt paint and wire brush clean all welds before touch-up.

D. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M or A490 Bolts" for type of bolt and type of joint specified.

E. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
   1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design, or Load and Resistance Factor Design Specification for Structural Steel Buildings" as required for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.05 FIELD QUALITY CONTROL

A. Owner will engage an independent testing agency who will perform field quality control tests, as indicated on the Drawings.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts,".

C. Ensure alignments and elevations are correct prior to welding or permanently fastening components together.

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
   1. In addition to visual inspection, field welds will be tested according to AWS D1.1 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 will not be accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94/E94M.

E. Remove temporary shoring, bracing, and guy lines.

F. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 051200

SECTION 052100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Open web steel joists, joist girders, joist accessories with bridging, attached seats and anchors.

B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.

C. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all structural metal framing work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to fabricating, delivering, and erecting structural metal framing, cutting, fitting, welding, cleaning, painting, providing temporary supports, and removing all temporary steel elements necessary for erection of structural metal.

D. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.02 REFERENCE STANDARDS

A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

B. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

C. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

F. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).

G. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

H. SSPC-SP 2 - Hand Tool Cleaning; 2024.

I. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of joist, accessory, and product indicated.

C. Shop Drawings: Showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
   1. Base drawings on Construction Documents, and details.
   2. Shop drawings shall clearly show layout of joists to include mark, type, size, spacing of joists and bridging, details at all field connections, and materials required.
   3. Submit complete shop fabrication details and erection diagrams. Such shop details and erection diagrams shall give all pertinent information of construction methods proposed, together with all required dimensions for the proper fitting for the connection with other work and materials.
   4. Submit complete joist/joist girder design calculations signed and sealed by a civil or structural engineer licensed in the state in which the project is located.
   5. Contract drawings shall not be reproduced for use as shop drawings.
   6. Fabrication shall not commence until approval is received from Structural Engineer and Architect.

D. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material test reports, substantiating compliance with requirements.

E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

F. Mill Test Reports.

G. Source quality control test reports.

H. Manufacturer's Qualification Statement.

I. Fabricator's Qualification Statement.

J. Erector's Qualification Statement.

1.04 QUALITY ASSURANCE

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

B. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

1. Welding: Qualify personnel according to AWS D1.1/D1.1M, "Structural Welding Code-Steel," and AWS D1.3/D1.3M, "Structural Welding Code--Sheet Steel." Qualify procedures per SJI requirements.

C. All open web steel joists and steel joist girders shall be of the type, size, and spacing as shown in the drawings and shall comply with the Steel Joist Institute (SJI) "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders", latest edition.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

B. Store all steel materials off the ground and protect materials from corrosion and deterioration. Store fasteners in a protected location. Clean and lubricate bolts and nuts that become dry or rusty before use.

C. Additional requirements for product delivery, storage and handling are in Section 016000.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A307-93, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers; plain, uncoated.

C. High-Strength Bolts and Nuts: ASTM F3125/F3125M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers; plain, uncoated.

D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.02 FINISH

A. Prepare surfaces to be finished in accordance with SSPC-SP 2.

B. All joists, joist girders and bridging members shall be cleaned of foreign matter and loose scale. After cleaning, these members shall receive one shop coat of gray primer which meets the minimum performance requirements of one of the following:
1. The Society for Protective Coatings (SSPC) 15-68T or,
2. Federal Specification TT-P-636.

C. Painting - Shop Coat
1. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning or power-tool cleaning per SJI requirements.
2. Apply 1 shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 0.5 mil (0.013 mm) thick.

3. Touch-Up Painting: After joist installation, field paint bolt heads and nuts and welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type paint as used for shop painting.

2.03 STEEL JOISTS

A. Manufacture steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Design steel joists and bridging for the wind net uplift loads specified on the drawings.

2.04 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specifications for Joist Girders," in SJI's "Specifications, "with steel-angle top- and bottom-chord members.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

2.05 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Bridging shall be located to avoid conflicting with skylights, exhaust fans, and roof top HVAC units.

C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Pre-Erection Survey: Check vertical and horizontal dimensions of all points of support/tie-in, before erection work proceeds and report discrepancies to Owner. Do not proceed with erection until corrections have been made, or until compensating adjustments have been agreed upon with Owner. Also report any other conditions detrimental to proper/timely completion of work.

C. Do not install joists until supporting construction is in place and secured.

3.02 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

D. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

E. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

F. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.

G. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM F3125/F3125M or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

H. Install and connect bridging concurrently with joist erection. No construction loads shall be allowed on the steel joists until all bridging is installed and anchored, and all joist bearing ends are attached. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. During the construction period, loads placed on the steel joists shall be distributed so as not to exceed the capacity of the steel joists.

J. The weight of a bundle of joist bridging shall not exceed a total of 1000 pounds. The bundle of joist bridging shall be placed on a minimum of 3 joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot of the secured end.

K. Inspection/Testing: Joists welded in place are subject to inspection/testing. Expense of removing/replacing any portion of steel joists for testing purposes will be born by Owner if welds are found to be satisfactory. Replace/remove work found to be defective and provide new acceptable work.

L. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

M. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

N. Do not field cut or alter structural members without approval of joist manufacturer.

END OF SECTION 052100

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SECTION 053100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The construction of all metal roof decking assemblies including fabrication of metal parts, fasteners, accessories, delivery, and installation.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all metal roof deck units, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to fabrication of the roof deck units and miscellaneous steel shapes, welding, fasteners, additional metal reinforcement and closure pieces, support of other work, cutting and fitting the deck units, accessories, cleaning, priming and painting.

C. All work shall be coordinated with other sections. Coordinate delivery with other work to avoid delay.

D. Bearing plates and angles.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.

E. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
   1. Shop drawings shall clearly show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special joints, accessories, and attachments to other construction. Also show designation, number, type, location and materials required.
   2. Note diaphragm deck welding pattern on shop drawings.
   3. Contract drawings shall not be reproduced for use as shop drawings.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

E. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. IInclude material test reports substantiating compliance with requirements.

F. Fabrication shall not commence until approval is received from Owner/Architect.

G. Product Certificates.

H. Field quality control test and inspection reports.

I. Research/Evaluation Reports: For steel deck.

J. No Substitutions on National Account items.

1.04 QUALITY ASSURANCE

A. Steel deck shall be fabricated in accordance with the requirements of Steel Deck Institute (SDI) Specification, the drawings, and as specified herein.

B. Panel configurations and method of forming shall be in accordance with SDI Specifications for type and gauge as indicated on the drawings.

C. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
   1. Welding: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.
   1. Sections and properties of metal shall conform to minimum Specifications for the design of "Light Gauge Cold Formed Steel Structural Members" as published by AISI.

E. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

1. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
3. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
4. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

F. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

G. Testing: As required by industry codes and standards.

H. Tolerances shall conform to applicable codes and standards, except as otherwise noted.

I. Warranty:
1. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
2. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.
3. Additional requirements for product warranties are included in Section 016000.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

C. Steel deck shall be handled with utmost care to minimize scratching and deformation. Deck units sustaining irreparable deformation/damage shall be replaced at the discretion of the Owner/Architect.

D. Exercise special care so as not to damage or overload the decking during the entire construction period.

E. Do not use metal decking for storage or as a working platform until the sheets have been welded in position.

F. If site storage is required, the bundles of deck shall be stored off the ground with one end elevated to provide drainage and should be protected against condensation with a ventilated waterproof covering.

G. Stack decking stored at the site before erection on platforms or pallets, and protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer.

H. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture.

I. Additional requirements for product delivery, storage and handling are in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
1. Canam Steel Corporation: www.canam-steeljoists.ws.
2. New Millennium Building Systems: www.newmill.com/#sle.
3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.

2.02 FABRICATION

A. General: Fabricate panels to comply with SDI specifications, and as indicated on the drawings.

B. Form deck units in lengths to span 3 or more support spacings, with flush, telescoped or nested 3" end laps and interlocking side laps, unless otherwise shown or specified.

2.03 STEEL DECK

A. Steel for Painted Deck: ASTM A1008/A1008M, Grade C.
1. Depth: As indicated on Structural Drawings.
2. Gauge: As indicated on Structural Drawings.
3. Width: As indicated on Structural Drawings.
4. Values (minimum):
   a. S per 1'-0" of width - As indicated on Structural Drawings.
   b. I per 1'-0" of width - As indicated on Structural Drawings.
   c. Minimum diaphragm shear - As indicated on Structural Drawings.

2.04 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.

B. Miscellaneous Steel Shapes: ASTM A36/A36M, unless otherwise noted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. Locate deck bundle in such a manner to prevent overloading of supporting members.

C. Install deck panels flat, square, and without any warp or deflection.

D. Cut and fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

E. Provide additional reinforcement and closure pieces as required for strength, and support of other work.

F. Comply with AWS requirements and procedures for quality, appearance, and methods for welding. All metal deck to be welded with E6022 Electrodes unless other electrodes are specifically approved by the Engineer of Record. All welders are to have “Light-Gage” certification per AWS requirements.

3.03 PLACING

A. Do not start placement of deck units before all supporting members are installed.

B. Place deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before being permanently fastened.

C. Lap ends not less than 2".

D. Do not stretch or contract the side-lap interlocks.

E. Do not place deck units on concrete supporting structure until concrete has cured properly and is dry.

F. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

G. Do not use deck units for storage or working platforms until permanently secured in position.

3.04 FASTENING

A. Permanently fasten deck units to steel supporting members by welds at end laps and at intermediate supports as indicated.

B. Comply with AWS requirements and procedures for manual shielded metal-arc welding, the appearance and quality of welds, and the methods used in correcting welding work.

C. Lock side laps between adjacent deck units at intervals not exceeding 12" O.C. by welding, screws, button punching, or as shown on structural documents.

3.05 CUTTING AND FITTING

A. Cut and fit deck units and accessories around other work projecting through or adjacent to the decking. Provide neat, square, and trim cuts.

3.06 REINFORCEMENT AT OPENINGS

A. Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work, unless otherwise shown.

3.07 TOUCH-UP PAINTING

A. After decking installation, wire brush, clean and paint scarred areas, welds, and rust spots on the top and bottom surfaces of decking units and supporting steel members.

B. Touch-up galvanized surfaces with galvanized repair paint applied in accordance with the manufacturer's instructions.

C. In areas where touch-up painted surfaces are to be exposed, apply the paint to blend into the adjacent surfaces in a manner that will minimize visual discontinuity in the coatings.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.09 REPAIRS

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on all surfaces of prime-painted deck immediately after installation and apply repair paint.

END OF SECTION 053100

SECTION 054000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall framing.

B. Formed steel joist and purlin framing and bridging.

C. Water-resistive barrier over sheathing.

D. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all heavy gauge framing assembly work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of structural steel studs and associated metal shapes, welding, reinforcement, support of other work, cutting, fitting, testing, cleaning and painting.

1.02 REFERENCE STANDARDS

A. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

B. AISI S400 - North American Standard for Seismic Design of Cold-Formed Steel Structural Systems; 2015, with Supplement (2016).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

H. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

I. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2024.

J. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2024.

K. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).

L. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; 2024.

M. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.

N. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

P. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

Q. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.

C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Stud manufacturer catalog printouts are not considered shop drawings and will not be accepted as such without the information indicated in this section.
   4. Contract drawings shall not be reproduced for use as shop drawings.

D. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material test reports substantiating compliance with requirements.

E. Mill and product test reports (or data from a qualified independent testing agency indicating steel sheet complies with requirements.)

F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before the start of scheduled welding work.

G. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.

H. Field quality control test and inspection reports.

I. Research/evaluation reports for Steel sheet, Expansion Anchors, Power-actuated Anchors, Mechanical fasteners, Vertical deflection clips.

J. Substitutions shall be requested in accordance with Sections 012500.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

D. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

E. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.
   1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   3. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   4. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

F. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within deflection limits and under conditions indicated.

G. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

H. Testing: As required by the latest industry codes and standards.

I. Tolerances shall conform to industry codes and standards, except as otherwise noted.

J. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

K. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.06 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturer offering products that may be incorporated into the work include the following:

B. Structural Framing:
   1. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. SCAFCO Corporation: www.scafco.com/#sle.
   3. The Steel Network, Inc: www.SteelNetwork.com/#sle.
   4. MBA Metal Framing.
   5. Approved equal.
   6. Substitutions: See Section 016000 - Product Requirements.

2.02 Performance Requirements

A. Regulatory Requirements: Comply with applicable building code criteria for loads, including seismic loads.
   1. Seismic Criteria: Comply with ASCE 7 and with local authorities having jurisdiction:
      a. Seismic Design Category: As indicated on the Drawings..
   2. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   3. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   4. Fabrication:

a. Shop-fabricate cold-formed framing systems and connectors to the greatest extent possible.
b. Deliver to project site in largest practical sections.
c. Where field cutting is required, saw cut all structural stud components squarely, or on an angle as in bracing, to fit squarely against abutting members.
   1) Hold members firmly in position until properly fastened.
d. Attach similar components by welding.
e. Attach dissimilar stud components by welding, screw attachment, or bolting.
f. Wire tying will not be permitted.

2.03 MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
   1. Structural Grade: As indicated on the Drawings and specified herein..

2.04 STRUCTURAL FRAMING COMPONENTS

A. Fabricate steel framing accessories from steel sheet, ASTM A1003/A1003M, structural grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.

B. Steel shapes and clips: ASTM A36/A36M, zinc coated by hot dip process according to ASTM A123/A123M.

C. Structural steel studs shall be sizes as indicated on the Drawings and as Specified herein.

D. Manufacturer’s standard C-shaped studs of web depths indicated, punched with stiffened flanges and as follows:
   1. Steel for load bearing steel studs, runners, and bracing or bridging shall conform to ASTM C955.
   2. Steel for non-structural steel framing studs shall conform to ASTM C645.
   3. Studs shall be type as indicated on the drawings, and as manufactured by Metal Stud Manufacturer’s Association.

E. Steel track: Manufacturer’s standard U-shaped steel track, of web depth indicated.

F. All structural stud components shall have a shop coat of rust resisting paint conforming to FS TT-P-636.

G. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

H. Provide jack studs or channels between bottom track and sill openings:
   1. Between opening and door lintel or headers and top track;
   2. Elsewhere as required to provide adequate support for collateral wall materials.

I. Provide sills and headers as required for all exterior wall openings.

J. Ceiling Joists and Runners: Galvanized sheet steel, C-shaped.

K. Headers: AISI S240; manufactured, engineered one-member or two-member assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.
   1. Jamb Mounting Clips: Manufacturer's standard.

L. Joists: AISI S240; manufactured, engineered open-web steel joists.

2.05 LATERAL FORCE-RESISTING SYSTEMS

A. CONNECTIONS
   1. Structural Performance: Maintain load and movement capacity required by applicable building code and specified design criteria.
   2. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
   3. Anchor bolts: ASTM F1554, Grade 36 threaded carbon steel hex head bolts with carbon steel nuts and flat hardened washers, zinc coated by hot dip process per ASTM A153/A153M.
   4. Expansion anchors fabricated from corrosion resistant material capable of handling a load five (5) times design load, per ASTM E488/E488M.

2.06 Miscellaneous Connections

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.

B. Mechanical fasteners: ASTM C1513, corrosion resistant coated.

C. Braces shall be 16 gauge with minimum flange width of 1-5/16".

2.07 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

C. Verify field measurements and adjust installation as required.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Installation - General

A. Install structural members and connections in compliance with ASTM C1007.

B. Install cold formed metal framing according to manufacturer’s written instructions, unless more stringent requirements are indicated on the drawings or the specifications herein.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Set studs plumb, except as needed for diagonal bracing or required for non plumb walls or warped surfaces and similar configurations.
   2. Where studs cannot be aligned, continuously reinforce track to transfer loads.
   3. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secure.

E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

F. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.03 INSTALLATION OF STUDS

A. Install wall studs plumb and level.

B. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Space studs on centers indicated but in no instance any further than 16" o.c.

E. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

F. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.

G. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.

H. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

I. Install intermediate studs above and below openings to align with wall stud spacing.

J. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.

K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

L. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.

M. Securely anchor track to floor as indicated on the Drawings.

N. Use butt welds or splices at all but joints in track.

O. Splices in studs will not be permitted.

P. All welds shall be fillet, plug, butt or seam as indicated on the drawings and made with 3/32” AWS Type E 6013, E6014, or E7014 rod with a welding heat of 60-110 Amperes.

Q. Provide cold rolled steel channel bridging minimum 1-1/2" deep with 9/16" flange 48" o.c. vertically, welded at each stud.

R. Secure headers or lintels by welding, bolts, or rivets as required.

S. Furnish and install 1/8" x 3" steel strap bracing as indicated on the Drawings.

3.04 INSTALLATION OF JOISTS and PURLINS

A. Install joists and fasteners in accordance with manufacturer's published instructions and, where gypsum board is attached to joists, install joists in accordance with ASTM C1007 and GA-216.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 12 inches on center beginning from center of room; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.

D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load-bearing studs or provide load distribution on top of stud track.

F. Touch-up field welds and damaged galvanized surfaces with primer.

G. Install joists in direction of shortest span, parallel and level, with lateral bracing and bridging.

H. Install joists in one piece full length. Splicing of joists not permitted.

I. Install perimeter joist runner track sized to match joists. Attach joist runner track to wall framing with minimum (4) #8 screws per stud and at corners and ends or as indicated on the Drawings.

J. Attach joist ends to joist runner tracks with minimum (4) #10 screw each side at each flange or as indicated on the Drawings.

K. Install bridging at 48 inches on center beginning from center of room with 1-1/2 inch rolled channels screw attached to joists. Stagger bridging at light fixtures as required.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide inspections for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.

C. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Field and shop welds will be subject to testing and inspecting.

E. Testing agency will report test results promptly and in writing to Contractor and Architect.

F. Remove and replace work where test results indicate that it does not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 TOLERANCES

A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft, in accordance with ASTM C1007.

B. Studs - Maximum Variation from True Position: 1/8 inch in accordance with ASTM C1007.

C. Stud Spacing: 1/8 inch from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

D. Space individual framing members no more than plus or minus 1/8" (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.07 PAINT

A. Touch-up field abrasions and welds in the field after erection using the same materials as shop coat paint.

3.08 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items.

B. Downspout boots.

1.02 SUMMARY

A. The extent of miscellaneous metal work is shown on the drawings and includes items fabricated from iron and steel, shapes, plates, bars, strips, tubes, pipe and castings which are not a part of the structural steel or other metal systems in other sections of these specifications.

B. These include but are not limited to the following: Carpenter's ironwork, steel frames, steel pipe bollards and guard posts, platforms, loose bearing plates, miscellaneous framing and supports, inserts and anchoring devices, miscellaneous steel trim, steel angle corner guards, steel channel door frames, steel dock angles, steel angle jambs, and steel overhead door supports where indicated on the Drawings.

C. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all miscellaneous metal items necessary to provide complete assemblies, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to fabrication, welding, cutting, fitting, drilling, punching, grout, testing, reinforcement, support of other work, making and submitting templates for anchors and bolts, cleaning and painting.

D. All work shall be coordinated with other sections. Coordinate delivery with other work to avoid delay.

1.03 REFERENCE STANDARDS

A. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012 (Reaffirmed 2021).

B. ASME B18.6.1 - Wood Screws (Inch Series); 1981 (Reaffirmed 2016).

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2024b.

D. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.

F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

H. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

J. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2024.

K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

L. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

M. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

N. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

O. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

P. ASTM A512 - Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing; Current Edition.

Q. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

R. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.

S. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.

T. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

Y. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

Z. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).

AA. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

BB. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

CC. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

DD. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of material, accessory, and product indicated.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
      a. Include the following, as applicable:
         1) Design criteria.
         2) Member sizes and gauges.
         3) Details of connections.
         4) Bracing requirements.
   3. Plans and elevations at not less than 1" to 1'-0" scale and include details of sections and connections at not less than 3" to 1'-0" scale.
   4. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.
   5. Fabrication and erection of all assemblies of miscellaneous metal work, which are not completely shown by the manufacturer's data sheets.
   6. Contract drawings shall not be reproduced for use as shop drawings.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

E. Welding Certificates.

F. Designer's Qualification Statement.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

H. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards.

I. Mill and product test reports.

J. Qualification Data.

K. Field quality control test and inspection reports.

1.05 QUALITY ASSURANCE

A. Comply with the provisions of the applicable codes, standards and specifications, including but not limited to those indicated on the drawings and specified herein.
   1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," including "Commentary of the AISC Specifications".
   2. AISI "Specifications for the Design of Cold-Formed Steel Structural Members".
   3. AWS "Structural Welding Code - Steel".
   4. ASTM A6/A6M "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piping and Bars for Structural Use".
   5. Occupational Safety and Health Administration (OSHA) Requirements
   6. State/local Building Codes
   7. Life Safety Code (NFPA 101)

B. Design 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.
   1. Structural Performance: Provide assemblies capable of withstanding design loads within limits and under conditions indicated.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

D. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

E. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
   1. Qualification for welding work. Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedure."

F. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

G. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

H. Manufacturer's instructions for installation shall be delivered and stored with the materials.

I. Testing: As required by industry codes and standards.

J. Field Measurements: Field measurements shall be taken prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work. However, do not delay job progress; allow for trimming and fitting wherever the taking of field measurements before.

K. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

A. Metal surfaces, general:
1. For the fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Remove such blemishes by grinding or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coatings.

2.02 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Cold-drawn Steel Tubing: ASTM A512, sunk drawn, butt welded, cold-finished and stress-relieved.

D. Plates: ASTM A283/A283M.

E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.

F. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

G. Hot-rolled Carbon Steel Bars: ASTM A108, Grade as selected by fabricator.

H. Hot-rolled Carbon Steel Sheets and Strips: ASTM A568/A568M and ASTM A1011/A1011M; pickled and oiled.

I. Cold-rolled Carbon Steel Sheets: ASTM A1008/A1008M.

J. Galvanized Carbon Steel Sheets: ASTM A653/A653M, with zinc coating.

K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

L. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

N. Non-shrink, nonmetallic grout per ASTM C1107/C1107M.

2.03 ANCHORS

A. Thread-type concrete inserts. Galvanized ferrous castings, internally threaded to receive 3/4" diameter machine bolts; either malleable iron complying with ASTM A47/A47M, or cast steel complying with ASTM A27/A27M; hot-dip galvanized in compliance with ASTM A153/A153M.

B. Wedge-type Concrete Inserts: Galvanized box-type ferrous castings, designed to accept 3/4" diameter bolts having special wedge-shaped heads, either malleable iron complying with ASTM A47/A47M or cast steel complying with ASTM A27/A27M; hot-dipped galvanized in compliance with ASTM A153/A153M.

C. Provide carbon steel bolts having special wedge-shaped heads, nuts, washers and shims; all galvanized in compliance with ASTM A153/A153M, as required to complete the work.
   1. Slotted-type Concrete Inserts: Galvanized 1/8" thick pressed steel plate complying with ASTM A283/A283M.
   2. Box-type welded construction with slot designed to receive 3/4" diameter square head bolt and with knockout cover.
   3. Hot-dip galvanized in compliance with ASTM A123/A123M.

D. Masonry Anchorage Devices: Expansion shield; FS FF-S-325.

E. Toggle Bolts: Tumble-wing type; FS FF-B-588, type, class and style as required.

2.04 FASTENERS

A. General: Provide galvanized, zinc-coated fasteners complying with ASTM A153/A153M for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items. Provide bolts, nuts, washers, and shims as needed.
   1. Bolts and Nuts: ASTM A307, Grade A, regular hexagon head.
   2. Bolts, hexagon and square: ASME B18.2.1.
   3. Bolts, round head: ANSI B-18.5.
   4. Lag Bolts: FS FF-B-561, square head type.
   5. Wood Screws: ASME B18.6.1, flat head carbon steel.
   6. Plain Washers: FS FF-W-84, helical spring type carbon steel.

2.05 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Workmanship:
   1. Use materials of the size and thickness shown, or if not shown, of the required sized and thickness to produce adequate strength and durability of the finished product for the intended use.
   2. Work to the dimensions of fabrication and support.
   3. Use the type of materials shown or specified for the various components of work.

F. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

G. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown.

H. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

I. Weld corners and seam continuously and in accordance with the recommendations of AWS.

J. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible.

K. Use exposed fasteners of the type shown, or if not shown, use Phillips flat head (countersunk) screws or bolts.

L. Provide for anchorage of type shown, coordinated with supporting structure and the progress schedule. Fabricate as required to provide adequate support for the intended use of the work.

M. Cut, reinforce, drill and tap miscellaneous metal work cleanly and accurately.

N. Use hot-rolled steel bars for work fabricated from bar stock, unless work is indicated to be fabricated from cold-rolled or cold-finished stock.

O. Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.

P. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

2.06 BOLLARDS

A. Idealshield bollard: Schedule 40 steel pipe bollard with 10 inch disk and cover.
   1. Performance Criteria - Comply with ASTM C40 P1 and F3016-F3016M S30 P1 standards.
   2. Location: As shown in the Drawings..
   3. Size: 6" diameter, height as indicated on the Drawings.
   4. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
   5. Finish: Manufacturer's standard galvanized finish.
   6. Installation: Standard (Permanent) installation with foundation footing design as required to meet manufacturer's minimum requirements.
   7. Accessories: Manufacturer's standard 1/4 inch high density polyethylene thermoplastic bollard cover (with installation tape.)
      a. Color: Custom color, Sprouts Farmers Market Green - PMS-2465
   8. Manufacturers:
      a. Idealshield.com; C40 Impact Bollard Series; www.idealshield.com.
      b. Substitutions: Not permitted.

B. Utility bollard:
   1. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.

2.07 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Prime Painting: One coat.

D. Shop paint miscellaneous metal work, except those members or positions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.

E. Remove scale, rust and other deleterious materials before the shop coat of paint is applied.
   1. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 "Hand Tool Cleaning", SSPC SP-3 "Power Tool Cleaning, or SSPC SP-7 "Brush-off Blast Cleaning".
   2. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".

F. Apply one shop coat of metal primer paint to fabricated metal items, except apply 2 coats of paint to surfaces which are inaccessible after assembly or erection.

G. Immediately after surface preparation, brush or spray on metal primer paint, applied in accordance with the manufacturer's instructions, and at a rate to provide a uniform dry film thickness of 2 mils for each coat.

H. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

I. Metal Primer Paint: FS TT-P-636.

J. Provide a zinc coating for those items shown or specified to be galvanized, using the hot-dip process after fabrications.
   1. ASTM A153/A153M for galvanizing of iron and steel hardware.
   2. ASTM A123/A123M for galvanizing of rolled, pressed and forged steel shapes, plates, bars, and strip 1/8" thick and heavier and for galvanizing of assembly projects.

K. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

L. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

M. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, complying with military specifications MIL-P-21035 (Ships).

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. General: Perform cutting, drilling, and fitting required for installing metal fabrications.

B. Install items plumb and level, accurately fitted, free from distortion or defects.
   1. Fit exposed connections accurately together.
   2. Weld connections that are not to be left as exposed joints but cannot be shop welded.
   3. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.
   4. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
   5. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

E. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts.
   1. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with non shrink, nonmetallic grout.

F. Touch up surfaces and finishes after erection.
   1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
   2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.04 MISCELLANEOUS METAL ITEMS

A. Carpentry’s Iron Work:
   1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures.
      a. Straight bolts and other stock rough hardware are specified in Division 6 Sections.
   2. Manufacture or fabricate items of sizes, shapes and dimensions required.

a. Furnish malleable iron washers for head and nuts which bear on wood structural connections; elsewhere furnish steel washers.

3.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide miscellaneous steel framing and supports which are not a part of the structural steel framework as required to complete the work.

B. Fabricate miscellaneous units to the sizes, shapes and profiles shown, or if not shown, of the required dimensions to receive adjacent grating, plates, doors or other work to be retained by the framing.

C. Fabricate from structural steel shapes, plates, and steel bars unless otherwise indicated on the drawings. Use all welded construction, mitered corners, welded brackets; splice plates, and a minimum number of joints for field connection.
1. Cut, drill and tap units to receive hardware and similar items to be anchored to the work.

D. Equip units with integrally welded anchor straps for casting into concrete or building into masonry wherever possible.
1. Furnish inserts if units must be installed after concrete is poured.
2. Space anchors 24" o.c. and provide minimum anchor units of 1-1/4" x 1/3 x 8" steel straps unless otherwise indicated on the drawings.

3.06 MISCELLANEOUS STEEL TRIM

A. Provide shapes and sizes as required for the profiles shown.

B. Fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges unless otherwise indicated on the drawings.

C. Use concealed field splices wherever possible.

D. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

3.07 STEEL PIPE BOLLARDS (UTILITY)

A. Anchor bollards to existing construction as indicated on the drawings.
1. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with non shrink, nonmetallic grout.
2. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.08 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

SECTION 055133
METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.02 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

F. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).

J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

L. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

F. Specimen warranty.

G. Executed warranty.

1.04 QUALITY ASSURANCE

A. Design ladders 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.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for material and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Plates: ASTM A283/A283M.

C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

D. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

E. Bolts, Nuts, and Washers: ASTM A307, plain.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

A. Fabricate ladders for the locations shown, with dimensions, spacing, details and anchorages as required.

B. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
   1. Side Rails: 1/2" x 2-1/2" continuous structural steel flat bar side rails with eased edges, spaced 18" apart.
   2. Rungs: 3/4 inch diameter solid round bar spaced 12 inches on center with non-slip surface.

C. Fit rungs into punched holes in centerline of side rails. Plug weld and grind smooth on outer rail faces.

D. Provide non-slip surfaces on the top of each rung, by coating the rung with aluminum oxide granules set in epoxy resin adhesive.

E. Alternate Bar rungs: McNichols grating rungs, spaced 12" o.c.

2.04 FINISHES - STEEL

A. Prepare surfaces to be primed in accordance with SSPC-SP2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. Support each ladder at top and bottom and at intermediate points spaced not more than 6'-0" o.c.
   1. Use welded or bolted steel brackets, designed for adequate support and anchorage, and to hold the ladder 6" clear of the wall surface and other obstructing construction.
   2. Extend rails 42" above top rung and return rails to wall or structure unless other secure handholds are provided.
   3. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure to provide secure ladder access.

E. Factory Paint or galvanize exterior ladders per Section 2.5 or 2.6 as required herein.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055133

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 Section Includes

A. Rough opening framing for doors, windows, and roof openings.

B. Sheathing.

C. Underlayment.

D. Roofing nailers.

E. Preservative treated wood materials.

F. Fire retardant treated wood materials.

G. Miscellaneous framing and sheathing.

H. Communications and electrical room mounting boards.

I. Concealed wood blocking, nailers, and supports.

J. Miscellaneous wood nailers, furring, and grounds.

1.02 GENERAL

A. This Section specifies the construction of all rough carpentry and related items including lumber, plywood, wood framing and assemblies, backing panels, blocking, furring, supports, miscellaneous lumber, fasteners, anchors, wood preservative and fire retardant treatment, finishing and painting.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all lumber products and related items required for the work as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to designing, furnishing, framing, reinforcing, support of other work, pressure treating, fastening, anchoring, testing, cutting, fitting, cleaning, finishing and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 061800 - Glued-Laminated Construction.

B. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.

1.04 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2024).

C. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

E. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.

F. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2023.

G. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.

H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. ITS (DIR) - Directory of Listed Products; Current Edition.

J. PS 1 - Structural Plywood; 2023.

K. PS 2 - Performance Standard for Wood Structural Panels; 2019.

L. PS 20 - American Softwood Lumber Standard; 2025.

M. UL (DIR) - Online Certifications Directory; Current Edition.

N. WCLIB (GR) - WCLB Standard Grading Rules for West Coast & Imported Softwood Lumber No.18; 2024.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein, specifically UL and FM requirements for fire retardants.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer's instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

C. Carefully store all lumber delivered to the site off the ground in a manner to assure proper drainage, ventilation, and protection from the weather.

D. Keep carpentry materials dry during delivery.
1. Store lumber and plywood in stacks.
2. Protect bottom of stacks against contact with damp or wet surfaces.
3. Protect exposed materials against weather.
4. Do not store dressed or treated lumber or plywood outdoors.

E. Store materials for which maximum moisture content is specified, only in areas where relative humidity has been reduced to a level where specified moisture content can be maintained.

F. Additional requirements for product delivery, storage and handling are in Section 016000.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

D. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
1. Species: As noted on the Drawings.

2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER

A. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, or specified herein.
1. Provide actual sizes complying with the minimum size requirements of PS 20 for the moisture content specified for each use.

C. Moisture Content: S-dry or MC19.

D. Stud Framing (2 by 2 through 2 by 6):
1. Species: Douglas Fir-Larch, values as indicated on the Drawings.
2. Grade: No. 2.

E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
1. Species: Douglas Fir-Larch, values as indicated on the Drawings.

F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
1. Lumber: S4S, No. 2 or Standard Grade.
2. Boards: Standard or No. 3.

2.03 EXPOSED DIMENSION LUMBER

A. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).

B. Sizes: Nominal sizes as indicated on drawings.

C. Surfacing: S4S.

D. Moisture Content: S-dry or MC19.

2.04 CONSTRUCTION PANELS

A. Roof Sheathing: PS 2 type, rated Structural I Sheathing.
1. Bond Classification: Exterior.
2. Span Rating: 60.
3. Performance Category: 5/8 PERF CAT.
4. Reference Structural Drawings for additional performance criteria.

B. Wall Sheathing, For exterior walls: PS 2 type.
1. Bond Classification: Exterior.

2. Grade: Structural I Sheathing.
3. Span Rating: 24.
4. Performance Category: 7/16 PERF CAT.
5. Edge Profile: Square edge.
6. Reference Structural Drawings for additional performance criteria.

C. Wall Sheathing, For back of house areas: Plywood, PS 1, Grade C-D, Exposure I.
1. Provide 1/2", 5/8”, 3/4", CDX 5-PLY, 3/4" Fire Retardant (FR) Plywood, 48" x 96", or as indicated on the Drawings.
2. Plywood: Provide plywood in accordance with the requirements of the U.S. Product Standard PS 1, for "Softwood Plywood/Construction and Industrial", except as otherwise specified herein.
3. Provide plywood of any PS 1 species classification group, except where species is indicated on the Drawings, Specified, or where PS 1 limits groups for particular grade specified.

D. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
1. OSB Board may be used on vertical surfaces (applications) only where indicated on the Drawings, and in accordance with local codes and standards. Refer to applicable Roofing Section for additional information.

E. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

F. Other Applications:
1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
3. Other Locations: PS 1, C-D Plugged or better.

2.05 Fire-Retardant Treatment (FRT)

A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.

B. For all wood members required by code to be fire retardant treated, comply with AWPA U1 requirements, and provide pressure impregnation with Dricon fire retardant chemicals, in accordance with the recommendations and quality control of Koppers Co., Inc. to provide a UL RFS Fire Hazard classification.

C. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898 .

D. Fire-1Retardant Treatment: Interior Type A, Use Category UCFA (LT), Low-Temperature (low hygroscopic).
1. Treat blocking and other wood members concealed in noncombustible construction.

2. Treat electrical and communications panel backer boards.
3. Treat wood in locations indicated on drawings.

E. Kiln-dry after treatment (KDAT) to maximum moisture content of 19 percent for sawn material and 15 percent for plywood.

F. Fabrication of FRT Wood:
1. Ripping or milling of boards, lumber, and timber after treatment is not permitted.
2. Field cutting to length and drilling of holes in boards, lumber, and timber are permitted without additional treatment.
3. Field cutting and drilling of holes in plywood are permitted.

G. Label or brand FRT wood with classification mark of UL (DIR) or ITS (DIR) or other approved inspection agency, the treatment plant, name of treatment, species of wood, flame spread and smoke developed index, method of drying after treatment, and treating standard.

2.06 Pressure-Preservative Treatment (PPT)

A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.

B. Preservative Limitations for Interior Use Categories UC1 and UC2:

C. Applications - Treat the Following:
1. Wood cants, nailers, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers and waterproofing (except plywood sheathing).
2. Wood sills, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete or below grade. Foundation Grade redwood, grade marked, is acceptable for wood sills in lieu of treated lumber.
3. Sleepers and sills on concrete or masonry in direct contact with earth: Use Category UC2, above ground, interior, damp.
4. Wood framing members in direct contact with interior of exterior masonry or concrete walls below grade: Use Category UC2, above ground, interior, damp.

D. Kiln-dry wood after treatment with waterborne preservative to maximum moisture content of 19 percent for lumber and 15 percent for plywood.

E. Fabricate to maximum extent possible before treatment.

F. Label preservative-treated wood with marking as required by AWPA U1 and ICC (IBC). Unless otherwise permitted by standard U1 and building code, include the following markings: AWPA U1, accredited inspection agency mark, treating plant identification, type of preservative, preservative retention, and permitted end use.

G. Field Treatment for Cuts and Holes in Preservative-Treated Wood: Comply with AWPA M4.

2.07 ACCESSORIES

A. Metal and Finish of Fasteners:
1. Fire-Retardant-Treated Wood:

a. Nails, timber rivets, wood screws, and lag screws: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.

2. Preservative-Treated Wood:
   a. Nails, timber rivets, wood screws, and lag screws - general use: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
3. Untreated Wood: Unfinished steel.

B. Fasteners and Anchors:
1. Select proper type, size, material, and finish for each application.

C. Materials not included in the above categories shall be provided in accordance with the following requirements:
1. Nails and Staples: FS FF-N-105
2. Wood Screws: ANSI B.18.6.1
3. Bolts, hexagon and square: ANSI B-18-2.1.
4. Bolts, round head: ANSI B-18.5
5. Nuts: FS FF-N-836
6. Washers: FS FF-W-92
7. Lag Screws or Lag Bolts: FS FF-B-561
8. Expansion Shields, Expansion Nails and Drive Screw Devices: FS FF-B-561
9. Toggle Bolts: FS FF-B-588.
10. Bar or strap Anchors: ASTM A525 size coated steel, 18-gauge minimum.
11. Metal Framing Connectors: Teco, Simpson or Kant Sag.

D. Allowable design loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

E. Sill Flashing: See Section 076200.

F. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

D. Obtain measurements, verify dimensions shown, and shop drawing details, before proceeding with carpentry work whenever possible.

E. Correlate location of furring, nailers, blocking, grounds, and similar supports, so that attached work will comply with design requirements.

F. Fit carpentry work to other work. Scribe and cope as required for accurate fit.

G. Time delivery and installation of carpentry work to avoid delaying other trades whose work is dependent on or affected by the carpentry work and to comply with protection and storage requirements.

H. Examine all parts of the supporting structure and the conditions under which the carpentry work is to be installed and notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work.

I. Use only sound, thoroughly seasoned, well manufactured materials of the longest practical lengths and sizes to minimize jointing.

J. Use materials free from warp, which cannot be easily corrected by anchoring and attachment.
   1. Sort out and discard warped material and material with other defects, which would impair the quality of the work

K. Securely attach carpentry work to substrates by anchoring and fastening as indicated on the drawings, and as required by applicable codes and standards.
   1. Provide washers under bolt heads and nuts in contact with wood.

L. Nail plywood to comply with AWPA recommendations.

M. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.

N. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit.

O. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

P. Framing Standard: Comply with AF & PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

Q. Shim with metal or slate for full bearing on concrete or masonry substrates.

3.03 ATTACHMENT AND ANCHORAGE

A. Use common wire nails, except as otherwise shown or specified herein.

B. Do not wax or lubricate fasteners that depend on friction for holding power.

C. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.

D. Make tight connections between members.

E. Install fasteners without splitting wood. Pre-drill holes as required.

F. Do not drive threaded friction type fasteners. Turn into place.

G. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.

H. Counter sink nail heads on exposed carpentry work and fill holes, use finishing nails for finish work.

3.04 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

G. Nail or spike members in accordance with code requirements.

H. All framing 16" o.c. unless otherwise noted.

I. Cut framing square on bearings, closely fit, accurately set to required lines and levels.

J. Secure rigidly in place at bearings and connections.

K. Do not use shims for leveling on wood or metal bearings.

L. Use steel shims with full bearing on masonry or concrete substrates.

M. Frame members for passage of pipes and ducts to avoid cutting structural members.

N. Do not cut, notch, or bore framing members for passage of pipes or conduits without Architect's permission.

O. Reinforce framing members as directed where damaged by cutting.

P. Provide Simpson NS nail stoppers over utilities that penetrate framing members, nailing with 8d nails.

3.05 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide wherever indicated on the drawings, and where required for screeding or attachment of other work.

F. Form to shapes as indicated on the drawings and cut as required for true line and level of work to be attached.

G. Provide solid wood backing and wood blocking inside stud wall construction for all wall mounted equipment and accessories, especially at toilet rooms.

H. Coordinate location with other work involved; refer to shop drawings of such work.

I. Attach to substrates securely with anchor bolts and other attachment devices as indicated on the drawings, and as required to support applied loading.

J. Countersink bolts and nuts flush with surfaces, unless otherwise shown.

K. Set true to line, level, and plumb, with intersections true to required angle.

L. Build into masonry as work progresses, cutting to fit masonry unit size involved.

M. Anchor to formwork before concrete placement.

N. Provide grounds of dressed, preservative treated, key-beveled lumber, not less than 1-1/2" wide and of the thickness required to bring face of ground to exact thickness of finish material involved.
   1. Remove temporary grounds when no longer required.

3.06 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. As indicated on the Drawings.

3.07 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Anchorage as indicated on the Drawings.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.08 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.09 WOOD FURRING

A. Install plumb and level with closure strips at all edges and openings.

B. Shim with wood as required.

3.10 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061800
GLUED-LAMINATED CONSTRUCTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glue laminated wood beams and columns.

B. Preservative treatment of wood.

1.02 RELATED REQUIREMENTS

A. Section 099300 - Staining and Transparent Finishing.

1.03 REFERENCE STANDARDS

A. ANSI A190.1 - Product Standard for Structural Glued Laminated Timber; 2022.

B. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions; 2012a (Reapproved 2024).

C. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

E. WCLIB (GR) - WCLB Standard Grading Rules for West Coast & Imported Softwood Lumber No.18; 2024.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, framed openings .

C. Contract Documents shall not be reproduced for use as Shop Drawings.

D. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance with ANSI A190.1.

B. Erector Qualifications: Company specializing in erection of products of the type specified with 5 years documented experience, and approved by manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Leave individual wrapping in place until finishing occurs.

PART 2 PRODUCTS

2.01 GLUED-LAMINATED UNITS

A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Architectural grade.
   1. Verify dimensions and site conditions prior to fabrication.
   2. Cut and fit members accurately to length to achieve tight joint fit.
   3. Fabricate member with camber built in.
   4. Do not splice or join members in locations other than those indicated without permission.
   5. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
   6. Welding: Perform welding in accordance with AWS D1.1/D1.1M.
   7. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

B. Performance Criteria:
   1. Comply with applicable code for loads, seismic zoning, and other load criteria.

2.02 MATERIALS

A. Lumber: Douglas Fir lumber complying with WCLIB (GR) grading rules with 12 percent maximum moisture content before fabrication. Design for the following values:
   1. As indicated on the Structural Drawings.

B. Laminating Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.

2.03 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. Preservative Pressure Treatment:
   1. Preservative Pressure Treatment of Glued-Laminated Structural Units: AWPA U1, Use Category UC2, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
      a. Kiln dry lumber after treatment and before lamination to maximum moisture content of 19 percent.
   2. Marking: Marked each piece with stamp of an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

C. Shop treat wood materials in accordance with manufacturer's instructions.

2.04 FABRICATION

A. Fabricate glue laminated structural members in accordance with AITC Architectural grade.

B. Verify dimensions and site conditions prior to fabrication.

C. Cut and fit members accurately to length to achieve tight joint fit.

D. Do not splice or join members in locations other than those indicated without permission.

E. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.

F. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

G. Field Finishing of Members: Specified in Section 099300.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports are ready to receive units.

B. Verify sufficient end bearing area.

3.02 ERECTION

A. Lift members using protective straps to prevent visible damage.

B. Set structural members level and plumb, in correct positions or sloped where indicated.

C. Provide temporary bracing and anchorage to hold members in place until permanently secured.

D. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.

E. Field Finishing: Specified in Section 099300.

3.03 TOLERANCES

A. Framing Members: 1/2 inch maximum from true position.

END OF SECTION 061800

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SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

1.02 SUMMARY

A. This Section specifies the construction of all architectural woodwork, casework, and related items including wood cabinets, trim, framing, laminate countertops, wood furring, blocking, shims, hanging strips (unless concealed within other construction before woodwork installation), hardware, finishing and installation.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all architectural woodwork, casework, and related items as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of woodwork, casework, trim, laminate countertops, and associated cutting, fitting, aligning, fastening, coping, bracing, reinforcing, cleaning and finishing.

C. Field Dimensions: The architectural woodwork manufacturer is responsible for details and dimensions not controlled by job conditions and shall show on his shop drawings all required field measurements beyond his control.
   1. The General Contractor and the woodwork manufacturer shall cooperate to establish and maintain these field dimensions.
   2. Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

D. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 123600 - Countertops.

1.04 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

B. AWI (QCP) - Quality Certification Program; Current Edition.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. BHMA A156.9 - Cabinet Hardware; 2020.

F. BHMA A156.11 - American National Standard for Cabinet Locks; 2019.

G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Clearly show layout, designation, number, type, location, dimensional plans and elevations, large scale details, attachment devices, and other components required.
   2. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   3. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

C. Product Data: For each type of cabinet, hardware, trim, countertop, and product indicated.
   1. Brochures: Submit manufacturer's descriptive literature of specialty items not manufactured by the architectural woodwork manufacturer.

D. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material and mill test reports, substantiating compliance with requirements.

E. Field quality control test and inspection reports.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
   2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
   3. Single Source Responsibility: Provide and install this work from single fabricator.

B. Installer Qualifications: The approved architectural woodwork manufacturer must have a reputation for doing satisfactory work on time and shall have successfully completed comparable work. The Architect reserves the right to approve the woodwork manufacturer selected to furnish all of the architectural woodwork.

C. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
   2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   6. Replace, repair, or rework all work for which certification is refused.

D. Manufacturer's instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, unless otherwise noted.

1.07 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

B. The architectural woodwork manufacturer and the contractor shall be jointly responsible to make certain that woodwork is not delivered until the building and storage areas are sufficiently dry so that the woodwork will not be damaged by excessive changes in moisture content.

1.09 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 STANDING AND RUNNING TRIM

A. AWI Quality Grade:
   1. Solid Wood: Custom.

2. For transparent-finished trim items wider than available lumber, use veneered construction. Do not glue for width.
3. Back out or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
4. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.02 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
1. Finish - Exposed Exterior Surfaces: Decorative laminate.
2. Finish - Semi-Exposed Surfaces: As governed by selected AWI quality grade.
3. Cabinet Style: Flush overlay.

2.03 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.04 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, Grade GP-28 as scheduled or as selected.

2.05 COUNTERTOPS

A. Countertops: See Section 123600.

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized finish in concealed locations and stainless steel finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.07 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: As indicated on drawings.
   2. Product Grade: Grade 2.

B. Shelf Standards: KV Standard 255 support 256, KV Standard 87 support 186.

C. Drawer and Door Pulls: Stainless Steel "Stapel" Pulls 5" x 2-1/2" x 5/16".

D. Drawer Guides: KV 1260

E. Drawer Locks: Where indicated on plans: BHMA A156.11, E07041.

F. Cabinet Catches:
   1. Magnetic catches, BHMA A156.9, B03141, Push-in magnetic catches, BHMA A156.9, B03131, Roller catches, BHMA A156.9, B03071, Ball friction catches, BHMA A156.9, B03013.

G. Hinges: European style concealed self-closing.

H. Door Locks: BHMA A156.11, E07121.

2.08 FASTENERS AND ANCHORAGES

A. Provide size type, material and finish as indicated on the drawings, as specified herein, as recommended by applicable standards, and complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.

B. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.

2.09 FIRE RETARDANT TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use Exterior Type or Interior Type A. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment.

B. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E84.

C. Fire-Retardant Fiberboard: ANSI A208.2 medium-density fiberboard panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E84.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.11 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Backing Sheet: NEMA LD 3, Grade CL-20.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Exposed woodwork shall have a smooth finish free from machine and tool marks, abrasions, raised grain or exposed surfaces.

H. All joints shall be tight.

I. Scribe and cope cabinets, shelving, trim, and partitions to fit abutting walls and other building surfaces.

J. Frames and trim shall have kerfed or hollow backs, and shall be in single lengths, except running trim shall be in commercial long lengths, with no splicing pieces shorter than 3'-0".
   1. At internal corners, square members shall be butt jointed, and the moulding coped.

2. At external corners, members shall be cut at a 45 deg angle to conceal shrinkage.
3. Brace frames at mill with cross and diagonal strips before shipping to job.

K. Set wood finish straight, plumb and level, in true alignment, and rigidly fastened in place.

L. Nailing and fastening shall be concealed where possible, and exposed nail heads shall be set for puttying.

M. Doors and other movable wood parts shall be accurately fitted with proper clearances and left in perfect working order.
1. All refitting necessary due to swelling, shrinking, faulty assembly, or installation shall be done by the contractor, without cost to the Owner, for a period of one (1) year after completion and acceptance of the building.
2. When dressing or cutting has been done, these surfaces shall be repainted or varnished.
3. The work shall be left clean and free from warp, twist, open joints, or other defects.
4. Doors and other movable wood parts shall be set for puttying.

N. Provide stops as indicated on the Drawings, as directed by the Architect or as required.

O. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

P. Install woodwork level, plumb, true, and straight to a tolerance of 1/8" in 96" (3 mm in 2400 mm). Shim as required with concealed shims.

Q. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

R. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails (or finishing screws) for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

S. Standing and Running Trim:
1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Scarf running joints and stagger in adjacent and related members.
3. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

T. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

U. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16" (400 mm) o.c. and as indicated on the Drawings.

3.03 PLASTIC LAMINATE

A. Core material shall be close grain hardwood veneered plywood.

B. Application of plastic shall be by pressure gluing using a water-resistant glue.

C. Backing sheets shall be used to prevent bowing.

D. Shop joints shall be allowed only when the required length of plastic is regularly available.

E. Field joints shall be shop prepared and pre-fitted with bolt-type fasteners.

F. Counter tops, intermediate supports, and splash backs shall be self-edged, and plastic edges shall return across all open ends.

G. Joints between tops and sides shall be square.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

I. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

3.04 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.05 PROTECTION

A. All finished millwork shall be covered and protected from damage and discoloration prior to final cleanup.

B. Damaged material shall be completely replaced.

3.06 CLEANING

A. Remove all scrap and unused material from jobsite.

B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

C. Leave in finished condition in accordance with the general conditions.

END OF SECTION 064100

SECTION 071400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polyurethane waterproofing.

B. Water-based asphalt emulsion waterproofing.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).

D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

F. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

H. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: For each type of waterproofing product specified, including:
   1. Technical data indicating compliance with requirements.
   2. Substrate preparation instructions and recommendations.

C. Shop Drawings: Show locations for waterproofing system components. Show details for each type of substrate, joints, corners, and edge conditions, including flashings, counterflashings, penetrations, transitions, and terminations.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Field quality control reports.

G. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A manufacturer-approved firm with minimum three years experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years experience installing similar work, and able to communicate verbally with Contractor, Architect, and employees.

B. Manufacturer Qualifications: A qualified manufacturer [listed in this Section] with minimum five years experience in manufacture of waterproofing as one of its principal products.
   1. Manufacturer's product submitted has been in satisfactory operation on five similar installations for at least five years.

C. Waterproofing Inspector Qualifications: An independent party certified as a waterproofing inspector by the SWRI or other certifying organization acceptable to Architect, retained by the Contractor and experienced in the installation and maintenance of the specified waterproofing system, qualified to perform observation and inspection specified in Field Quality Control Article, to determine Installer’s compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification.

1.05 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Mockups: Provide waterproofing mockup application within mockups required in other sections, or if not specified, in an area of not less than 150 sq. ft. (14 sq. m) of surface where directed by Owner for each type of substrate condition. Include examples of surface preparation, crack and joint treatment, waterproofing application, and flashing, transition, and termination conditions, to set quality standards for execution.
   1. Include intersection of deck waterproofing with adjacent vertical waterproofing and moisture control system.

C. Locate where directed.

D. Mock-up may remain as part of work.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer agrees to furnish waterproofing material to repair or replace those materials installed according to manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.
   1. Access for Repair: Owner shall provide unimpeded access to the Project and the waterproofing system for purposes of testing, leak investigation, and repair, and shall reinstall removed cladding and overburden materials upon completion of repair.
   2. Cost Limitation: Manufacturer's obligation for repair or replacement shall be limited to the original installed cost of the work.
   3. Warranty Period: Two (2) years date of Substantial Completion.

1.08 PERFORMANCE REQUIREMENTS

A. General: Waterproofing system shall be capable of performing as a continuous watertight installation and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Waterproofing shall accommodate normal substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.

B. VOC Content: 250 g/L maximum per 40 CFR 59, Subpart D (EPA Method 24) and complying with requirements of authorities having jurisdiction.

C. Compatibility: Provide waterproofing system materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by waterproofing manufacturer based on testing and field experience.

D. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer.
   1. Protect substrates from environmental conditions that affect waterproofing performance.
   2. Do not apply waterproofing during snow, rain, fog, or mist.

1.09 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in manufacturer's unopened original packaging.

B. Store products in weather protected environment, clear of ground and moisture, within temperature ranges recommended by waterproofing manufacturer.

C. Construction Waste: Store and dispose of packaging materials and construction waste in accordance with requirements of Division 1, Section 017419 - Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.01 FLUID-APPLIED WATERPROOFING MATERIALS

A. Polyurethane Waterproofing: Cold-applied, high solids content polyurethane waterproofing complying with ASTM C836/C836M.
   1. Cured Thickness: 60 mil, 0.060 inch, minimum.
   2. Tensile Strength: 200 psi, minimum, measured in accordance with ASTM D412.
   3. Ultimate Elongation: 600 percent, minimum, measured in accordance with ASTM D412.
   4. Durometer Hardness, Type 00: 50, minimum, in accordance with ASTM D2240.
   5. VOC Content: Less than 100 g/L, roller and self-leveling grades.
   6. VOC Content: Less than 160 g/L, trowel detailing grade.
   7. Hardness, ASTM D2240: 70 – 80.
   8. Low Temperature Flexibility and Crack Bridging, ASTM C 1305: Pass.
   9. Adhesion in Peel, ASTM C794: 26 lbf/in. (4553 N/m).
   10. Products:
      a. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: www.tremcosealants.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

B. Water-Based Asphalt Emulsion Waterproofing:
   1. Cured Thickness: 60 mil, 0.060 inch, minimum.
   2. Suitable for installation over metal substrates.
   3. Water Vapor Permeability: 0.02 perm, maximum, measured in accordance with ASTM E96/E96M.
   4. Products:
      a. Henry (A Carlisle Coatings & Waterproofing, Company); Henry 107 Asphalt Emulsion Sealer and Damp Proofer: www.henry.com
      b. Substitutions: See Section 016000 - Product Requirements.

2.02 ACCESSORIES

A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete waterproofing system meeting performance requirements, and compatible with waterproofing material and adjacent materials.

B. Substrate Patching Material: Waterproofing manufacturer's standard trowel-grade filler material.

C. Primer: Liquid primer meeting VOC limitations and recommended for substrate by waterproofing manufacturer.

D. Elastomeric Detail Sheet: Blended thermoset elastomeric sheet reinforced with polyester woven scrim.
   1. Basis of Design Product: Tremco, TRA Elastomeric Sheeting.

E. Metal Termination Bars: Waterproofing manufacturer's standard aluminum or stainless steel termination bar, with stainless steel fasteners.

F. Termination Mastic: Waterproofing manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade, with recommended glass-fiber-mesh tape.

G. Joint Sealant: ASTM C 719, high performance, medium-modulus, low-VOC, UV-stable, non-sag polyurethane sealant approved by waterproofing manufacturer for adhesion and compatibility with waterproofing and accessories.
   1. Basis of Design Product: Tremco, Dymonic 100.

H. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.

I. Protection Mat: Polyester mat at least 14 oz/sq yd to protect vertical or horizontal waterproofing membranes.
   1. Waterproofing manufacturer's standard protection course material recommended for application.
   2. Thickness: 100 mil, 0.10 inch, minimum.
   3. Width: 40 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
   1. Verify concrete and masonry surfaces are free from release agents, curing agents, laitance, and other contaminates. Test for waterproofing adhesion per manufacturer's recommended method. Notify Architect of unsatisfactory conditions.
   2. Verify masonry joints are filled with mortar and struck flush.

C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

E. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 INTERFACE WITH OTHER WORK

A. Sequencing of Work: Coordinate sequencing of waterproofing work with work of other sections that form portions of building envelope moisture control to ensure that flashings and transition materials can be properly installed and inspected.

B. Subsequent Work: Coordinate waterproofing work with work of other sections installed subsequent to waterproofing to ensure complete inspection of installed waterproofing and sealing of waterproofing penetrations necessitated by subsequent work.

3.03 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
   1. Mask adjacent finished surfaces.
   2. Remove contaminants and film-forming coatings from substrates.
   3. Remove projections and excess materials and fill voids with substrate patching material.
   4. Prepare and treat joints and cracks in substrate per ASTM D4258 and waterproofing manufacturer's written instructions.

C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials. Prepare non-moving shrinkage cracks, large cracks, construction joints, expansion joints, projections and protrusions, penetrations, drains, and changes in plane in accordance with waterproofing manufacturer's written instructions and details, using accessory materials specified. The following are two acceptable options for detail preparation:
   1. Adhere strips of elastomeric sheet to moving expansion joints on both sides in conjunction with a metal termination bar embedded in a layer of cold fluid-applied waterproofing and overlay with coat of cold fluid-applied waterproofing.
   2. Apply single-component urethane within moving expansion joints and overlay with a coat of cold fluid-applied waterproofing.

E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

F. Transitions to Adjacent Materials: Apply Tremco Approved Primer to transition cold fluid-applied waterproofing membrane to adjacent components of the building envelope.

3.04 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.

B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

C. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.

D. At joints from 1/2 inch to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch, and extend sheet at least 6 inches on either side of expansion joint.

E. Center joint cover sheet over joints, roll sheet into 1/8 inch thick coating of waterproofing material and apply second coat over sheet extending at least 6 inches beyond sheet edges.

F. Apply extra thickness of waterproofing material at corners, intersections, and angles.

G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

H. Seal membrane and flashings to adjoining surfaces.

3.05 INSTALLATION - PROTECTION BOARD

A. Protection Course: Cover waterproofing with protection course following curing of waterproofing and prior to backfilling or subjecting installation to traffic. Overlap protection course joints.

3.06 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Contractor's Inspector: Contractor shall engage manufacturer's qualified Inspector full-time during the Work to perform tests and inspections, including documenting of waterproofing prior to concealment.
   1. Contractor's Inspector shall measure membrane thickness with a wet film gauge during the application process at least once for every 100 sq. ft. (10 sq. m).
   2. Provide written report of tests and inspections.

C. Reporting: Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed.

D. Correction of Work: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.07 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

B. Clean spills, stains, and overspray resulting from application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.

C. Protect waterproofing from damage from subsequent work. Protect waterproofing materials from exposure to UV light for period in excess of that acceptable to waterproofing manufacturer; replace overexposed materials and retest.

END OF SECTION 071400

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at perimeter foundation wall and underside of floor slabs.

B. Batt insulation in exterior roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 SUMMARY

A. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, deliver, and install insulation work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to installing insulating materials and associated cutting, fitting, fastening, taping, and cleaning.

B. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 072119 - Foamed-In-Place Insulation - Installation requirements for insulation within masonry walls cells.

B. Section 075300 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

C. Section 092116 - Gypsum Board Assemblies - Installation requirements for acoustic (sound batt) insulation

1.04 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

E. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.
   1. Fire Test Response Characteristics: Provide insulation and related materials with the fire test response characteristics indicated, as determined by testing identical products per ASTM E84 for surface-burning characteristics and other methods indicated with product, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Identify materials with appropriate markings of applicable testing and inspecting agency.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.07 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation (Above grade): Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   4. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Square Edge : building.dupont.com/#sle.
      b. Kingspan Insulation LLC; GreenGuard GG25-LG XPS Insulation Board: www.kingspan.com/#sle.
      c. Owens Corning Corporation; FOAMULAR Type 250 Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

B. Extruded Polystyrene (XPS) Board Insulation (below grade): Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.
   2. Board Edges: Square.
   3. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Highload 40 : building.dupont.com/#sle.
      b. Owens Corning Corporation; FOAMULAR Type 400 Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
   1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   2. Products:
      a. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle. (Basis of Design)
      b. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.

B. Insulation Fasteners: Appropriate for purpose intended.
   1. Type and size indicated on the drawings or as recommended by insulation manufacturer for type of application and substrate.

C. Adhesive: Type recommended by insulation manufacturer for application.
   1. Waterproof type, acceptable to manufacturer of insulation board. Adhesive VOC shall be within the limits of not greater than 70 g/L in accordance with the California's South Coast Air Quality Management District (SCAQMD 1168).

D. Low voltage electrical wiring not in conduit shall meet the latest edition of the Energy Code (IECC) and local code requirements: Provide Teflon coated wiring as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

C. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified.

D. Obtain installer's written report listing conditions detrimental to performance of work in this section.

E. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

F. Clean substrates of substances harmful to insulation or vapor retarders, including removal of projections, which might puncture vapor retarders.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
   1. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations.

2. If no specific method is indicated, bond units to substrate with adhesive or use mechanical fasteners to provide permanent placement and support of units.

B. Extend insulation full thickness over entire area to be insulated.
1. Cut and fit tightly around obstructions and fill voids with insulation.
2. Remove projections, which interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

D. Install insulation that is new, undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

E. Extend insulation in thickness indicated to envelop entire area to be insulated.

F. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

G. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.
1. Place boards to maximize adhesive contact.
2. Install in running bond pattern.
3. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Coordinate with concrete Sections of Division 3 for timely placement of insulation board.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

D. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

E. Install two layers of insulation board in areas beneath freezers. Refer to Drawings for locations and details.

3.05 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.06 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:
   1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

3.07 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

B. General: Protect installed insulation from possible physical abuses, where possible by non-delayed installation of concealing work or where that is not possible, by temporary cover or enclosure.

END OF SECTION 072100

SECTION 072119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In masonry cavity walls.

1.02 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Installer will blend resin and foaming catalyst according to the manufacturer's instructions prior to arriving at the jobsite and/or at the jobsite, at the installer's discretion.

B. Storage and Handling:
   1. Materials should be stored in original paper packages and boxes protected from moisture until used by installer.
   2. Once blended with water by installer, materials must be maintained at a minimum temperature of 75ºF.

1.05 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. The wall assembly must be essentially dry with no standing water in the CMU core cells and no visible wetness on exterior surfaces.

C. Mortar must be adequately cured prior to installation of foam insulation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foamed-In-Place Insulation:
1. Basis of Design: Core Foam Masonry Foam Insulation by cfiFOAM, Inc., PO Box 10393, Knoxville, TN 37939. Phone: (800) 656-3626 or local at (865) 588-4465. Email: info@cfifoam.com (Note: In CA, CT, NJ and NH the aminoplast foam insulation shall be InsulSmart MH® by cfiFOAM, Inc. or equal. Aminoplast foam insulation shall not be installed in MA.)
2. Applegate C Foam by Applegate R Foam, Inc., 3335 Lincoln Road, Hamilton, MI 49419. Telephone: (855) 949-2775. Email: heuerinsul8@charter.net
3. Core-Fill 500 by Tailored Chemical Products, Inc., P.O. Box 4186, Hickory, NC 28603. Telephone: (800) 627-1687.
4. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Description: Cellular plastic insulation comprised of a spray-dried polymeric resin and a foaming catalyst concentrate that are combined with water for injection, along with compressed air, into the wall cavity by an authorized installer.

B. Test Data:
1. Surface Burning Characteristics – ASTM E84 or UL 723: Class A or Class I
   a. Flame Spread: 25 or Less
   b. Smoke Density: Less than 450
   c. Thickness: 3.5 inches (maximum thickness per test apparatus).
   d. Tests performed by an independent, accredited laboratory located within the USA

C. Thermal Performance (foam) – ASTM C177 or ASTM C518:
1. k-Value: k-0.23/inch @ 75ºF mean temperature.
2. R-Value: R-4.4/inch @ 75ºF mean temperature.

D. Potential Heat – NFPA 259
1. Potential Heat ≤ 8000 Btu/lb.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

C. Verify that mortar is adequately cured.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

C. Select the best location(s) to inject foam:
   1. Preferably through wall surfaces to be covered.
   2. 5/8”-7/8” holes to be drilled in masonry joints or directly through CMU face walls.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. All empty core cells and voids within each insulated wall shall be filled with foam insulation.

C. Apply insulation by spray method, to a uniform monolithic density without voids.

D. Walls can be filled using either top-fill or by pressure-injection techniques.
   1. For top-fill, the installer must use an extension tube to begin installing foam from the bottom of the cavity, withdrawing the extension tube as foam fills the cavity.
   2. For pressure-injection, holes are drilled in each CMU—3/8” holes for visually sensitive areas for use with a low-volume touch-up gun, 5/8” holes for use with a standard foam gun, or 7/8” holes for use with a high-volume production gun—at an approximate height of four feet from finished floor level. Normally each vertical cell column is drilled and injected with foam in 10’-24’ lifts.
   3. Aminoplast masonry foam insulation is injected until it completely fills each vertical cell column, as evidenced by foam exiting adjacent injection holes. Repeat steps 1 and 2 at intervals of 10’ to 14’ above the initial row of injection holes, or as needed, until the wall is completely filled. Exit holes may be drilled beneath bond beams and at tops of walls to help visually verify complete foam filling.

E. Patch damaged areas.

F. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

G. After foam insulation sets, remove excess foam from outside of cavity, sweeping the wall and floor as needed. Cured foam is an inert material and, therefore, can be disposed of with other construction waste or worked into soils on-site in accordance with local regulations.

H. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Field inspections and tests will be performed by an independent testing agency.

C. Inspection will include verification of insulation thickness and density.

D. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

B. Product should be protected from excess moisture during initial 24-hour curing period after installation. A 72-hour curing period is normally required prior to painting.

C. Foam should not be exposed to surfaces over 190°F for sustained periods of time.

END OF SECTION 072119

SECTION 074113
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal roof panel system of preformed steel panels.

1.02 RELATED REQUIREMENTS

A. Section 077200 - Roof Accessories for Snow Guards

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products; 2018.

D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

G. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2022.

H. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2025.

I. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.

K. ASTM E1514 - Standard Specification for Structural Standing Seam Steel Roof Panel Systems; Current Edition.

L. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2025.

M. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; 1995 (Reapproved 2024).

N. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems; 2016 (Reapproved 2022).

O. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

P. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS (FLORIDA PROJECTS ONLY)

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
1. Show work to be field-fabricated or field-assembled.

C. Maintenance Data: For metal panels to include in maintenance manuals at Closeout.

D. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.

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

1.06 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. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

C. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

D. 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.

1.07 FIELD CONDITIONS

A. Do not install metal roof panels, underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

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:
   2. Color fading more than 5 Hunter units when tested according to ASTM D2244 .
      a. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      b. Cracking, chipping, peeling, or failure of paint to adhere to bare metal.
   3. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Installer Warranty: Furnish a written warranty signed by the Panel Applicator guaranteeing materials and workmanship for watertightness of the roofing system, flashings, penetrations, and against all leaks.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Architectural Metal Roof Panel Manufacturers:
   1. Berridge Manufacturing Company; Cee-Lock Panel: www.berridge.com/#sle. (Basis of Design), Contact: Mark Eaker at Berridge for pricing. Phone: (702) 241-3943, Email: meaker@berridge.com
   2. Englert, Inc; S2000: www.englertinc.com/#sle.
      a. **NOTE: FOR USE ON PROJECTS ONLY WITHIN 10 MILES OR LESS OF SEA COAST OR SALT WATER ONLY.**
      b. 16” Width, .032” aluminum, color: medium bronze.
   3. Substitutions: Not permitted.

2.02 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Wind Loads: As indicated on the Drawings.
4. Other Design Loads: As indicated on the Drawings.
5. Wind Uplift: Class 90 wind uplift resistance of UL 580.
6. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 6.24 lbf/sq ft, when tested according to ASTM E1680.
    a. Test-Pressure Difference: 6.24 lbf/sq. ft.
7. Water Penetration: No water penetration when tested in accordance with procedures and recommended test pressures of ASTM E1646; perform test immediately following air infiltration test (at a minimum differential pressure of 20% of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. (300 Pa) and not more than 12.0 lb/sq. ft. (575 Pa).
8. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 120 degrees F.
    a. 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
9. Fire-Test-Response Characteristics: Where indicated, provide products identical to those tested for fire resistance per ASTM E119 by a testing agency acceptable to authorities having jurisdiction.
    a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    b. Identify products with appropriate markings of applicable testing and inspecting agency.
10. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA (ASMM)) Architectural Sheet Metal Manual.

2.03 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
    1. Unless more stringent requirements are indicated, comply with ASTM E1514.

B. Metal Panels: Factory-formed panels with factory-applied finish.
    1. Steel Panels:
        a. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 coating.
        b. Steel Thickness: Minimum 24 gauge, 0.024 inch.

2. Profile: Standing seam, with minimum 1-1/2-inch seam height; concealed fastener system for field seaming with special tool.
3. Texture: Smooth.
4. Width: Maximum panel coverage of 16.5 inches.

2.04 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

B. Clips: Continuous Cee-Rib with Vinyl Weatherseal Insert to accommodate thermal movement.
1. Material: 0.024-inch nominal thickness, aluminum-zinc alloy-coated steel sheet.

2.05 CONCEALED FASTENER, LAP-SEAM METAL WALL PANELS (AT SIDE OF AWNINGS)

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. V- Groove-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges.
1. Basis of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; Vee-Panel: Contact: Mark Eaker at Berridge for pricing. Ph: (702)-241-3943. Email: meaker@berridge.com
   a. Substitutions: Not Permitted.
2. Metallic Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M
   a. Nominal Thickness: 0.024 inch.
   b. Exterior (Factory) Finish: Organic Coating (Kynar 500 or Hylar 5000): Fluoropolymer, two-coat, thermocured system with fluoropolymer coat.
   c. Painted materials shall have a removable plastic film to protect the paint during roll forming, shipping and handling.
   d. Color: As indicated on the Drawings. Furnish appropriate long-life air-drying system finish in matching color for touchup.
   e. Size: As indicated in the Drawings.

2.06 SECONDARY FRAMING

A. Miscellaneous Metal sub-framing and Furring: 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. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

2.07 FABRICATION

A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

C. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using factory set, non-adjustable, 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.

D. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA (ASMM)'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. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA (ASMM) standards.
   3. 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 (ASMM)'s "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.08 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. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as indicated on drawings.

D. Color: As indicated on the Drawings. Furnish appropriate long-life air-drying system finish in matching color for touchup.

E. Color Change and Fade Resistance: No cracking, peeling, blistering or loss of adhesion when tested in accordance with ASTM D2244 and ASTM D4214; color change, after removal of surface deposits such as dirt or chalk, maximum 5 Δ Hunter units.

F. Humidity Resistance: No blistering, peeling or loss of adhesion, after 2000 hours testing in accordance with ASTM D2247.

2.09 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
   1. 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.
   2. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA (ASMM)'s "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
   3. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA (ASMM)'s "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
   2. Joint Sealant: 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. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   4. Concealed Sealant: Non-curing butyl sealant or tape sealant.

5. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Panel Fasteners: Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size as approved for the applicable loading requirements.

E. Underlayment: High-temperature, self-adhering polymer modified asphalt sheet complying with ASTM D1970/D1970M, with strippable release film and top surface of woven polypropylene sheet.
1. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
2. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
3. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
4. Products:
a. Grace Ice and Water Shield as manufactured by GCP, Applied Technologies, Cambridge, MA
b. VersaShield as manufactured by GAF

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. 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.

D. 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.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

C. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

E. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. 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 36 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days or as directed by the underlayment product manufacturer.
   1. Apply over the entire roof surface.
   2. Install flashings to cover underlayment to comply with requirements specified in Section 076200 - Sheet Metal Flashing and Trim.

B. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
   3. Shim or otherwise plumb substrates receiving metal panels to be level to 1/4 inch in 20 ft. (6 mm in 6.1 m).
   4. Flash and seal metal panels at perimeter of all openings. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   5. Locate and space fastenings in uniform vertical and horizontal alignment.
   6. Install flashing and trim as metal panel work proceeds.
   7. Panels should be continuous without end laps.
   8. Align bottoms of metal panels and fasten.
   9. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

C. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

1. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
2. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
    a. Provide elbows at base of downspouts to direct water away from building.
    b. Connect downspouts to underground drainage system where indicated.
3. Roof Curbs: Install flashing around bases where they meet metal roof panels.
4. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

D. 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.

E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

F. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
1. 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.
2. Install clips to supports with self-tapping fasteners.
3. Install pressure plates, if required, at locations indicated in manufacturer's written installation instructions.
4. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied vinyl weatherseal.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA (ASMM)'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.

3.04 FIELD QUALITY CONTROL

A. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

B. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

C. Prepare test and inspection reports.

3.05 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

B. 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.

3.06 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 074113

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SECTION 074646
FIBER-CEMENT SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiber-cement siding.

1.02 SUMMARY

A. This Sections specifies fiber cement lap siding, panels (including soffit panels), trim, fascia, moulding and accessories.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, fabricate, deliver, and install all siding panels, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to installation of the lap siding and related water proofing, closure pieces, support of other work, cutting and fitting the siding, accessories, cleaning, priming and painting.

C. All work shall be coordinated with other sections. Coordinate delivery with other work to avoid delay

1.03 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Water-resistive barrier under siding.

B. Section 099000 - Painting and Coating: Field painting.

1.04 REFERENCE STANDARDS

A. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022, with Editorial Revision (2023).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
   1. Manufacturer's requirements for related materials to be installed by others.

2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods, including nail patterns.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than two years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.

C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

1.08 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.09 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.10 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide manufacturer's 30-year warranty against manufactured defects in fiber cement panels.

C. Provide manufacturer's 30-year warranty against manufactured defects in panel finish.

D. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

E. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

A. Siding: Vertically oriented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment. Complies with ASTM E 136 as a noncombustible material and with ASTM E84 Flame Spread Index = 0, Smoke Developed Index = 5.
   1. Texture: Smooth.
   2. Length: 12'-0"
   3. Width: 10.25 inches.
   4. Thickness: 5/8 inch, nominal.
   5. Joint Pattern: As indicated on the Drawings.
   6. Finish: Factory applied primer.
   7. Color: As indicated on drawings.
   8. Warranty: 30 year limited; transferable.
   9. Products:
      a. James Hardie Building Products, Inc; Artisan HZ10 Square Channel Siding with Lock Joint System.: www.jameshardie.com/#sle. (Preferred Option)
      b. Nichiha USA, Inc; AWP 3030: www.nichiha.com/#sle, 6465 E. Johns Crossing, Suite 250, Johns Creek, GA 30097, Phone: 1.866.424.4421, Office: 470.882.9466, Fax: 770.805.9467. (Alternate Option)
      c. Substitutions: Not permitted.

B. Soffit Panels: Non-vented and vented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
   1. Type: HardieSoffit HZ10 Vented Panels. as manufactured by James Hardie Building Products, Inc.: (locations where indicated in the Drawings)
   2. Texture: Cedarmill.
   3. Length: 96 inches, nominal.
   4. Width: 12 inches.
   5. Thickness: 1/4 inch, nominal.
   6. Finish: Factory applied primer.
   7. Color: As indicated on drawings.

8. Net Free Ventilation: 5 sq inches of net free ventilation per linear foot (10583 sq mm per linear meter
9. Factory sealed on 5 sides.
10. Manufacturer: Same as siding.

2.02 ACCESSORIES

A. Trim:
1. HardieTrim HZ10 boards as manufactured by James Hardie Building Products, Inc.
   a. Product: 5/4 Boards, 3-1/2 inch (89 mm) width.
   b. Product: 5/4 Boards, 5-1/2 inch (140 mm) width.
   c. Product: 5/4 Boards, 7-1/4 inch (184 mm) width.
   d. Product: 5/4 Boards, 9-1/4 inch (235 mm) width.
   e. Product: 5/4 Boards, 11-1/4 inch (286 mm) width.
   f. Texture: Rustic.
   g. Length: 12 feet (3658 mm).
   h. Thickness: 1 inch (24 mm).
2. HardieTrim HZ10 Fascia boards as manufactured by James Hardie Building Products, Inc.
3. Fiber-cement trim - complies with ASTM C1186, Type A Grade II.
4. Fiber-cement trim - complies with ASTM E136 as a noncombustible material.
5. Fiber-cement trim - complies with ASTM E84 Flame Spread Index = 0, Smoke Developed Index = 5.
6. Intertek Product Listing.

B. Weather Barrier:
1. HardieWrap Weather Barrier as recommended by Manufacturer.
2. Install Engineered for Climate HardieWrap weather barrier in accordance with local building code requirements.
3. Use HardieWrap Seam Tape and joint and laps.
4. Install and HardieWrap flashing, HardieWrap Flex Flashing.

C. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inches, minimum.
1. Metal Framing: 1-1/4 inches (32 mm) No. 8-18 by 0.375 inch (9.5 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.
2. Metal Framing: 1-5/8 inches (41 mm) No. 8-18 by 0.323 inch (8.2 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.
3. Metal Framing: 1 inch (25 mm) No. 8-18 by 0.323 inch (8.2 mm) head self-drilling, corrosion resistant ribbed buglehead screws.
4. Metal Framing: 1 inch (25 mm) No. 8-18 by 0.311 inch (7.9 mm) head self-drilling, corrosion resistant S-12 ribbed buglehead screws.
5. Metal Framing: 1.5 inch (38mm) [AGS-100] .100 inches by 25 inches (2540 mm by 635 mm) ET&F Pin or equivalent pneumatic fastener.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

B. Verify that water-resistant barrier has been installed over substrate completely and correctly.
   1. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
   2. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Metal Framing: As shown on the Drawings.

3.02 PREPARATION

A. Protect surrounding areas and adjacent surfaces during execution of this work.

B. Clean surfaces thoroughly prior to installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

D. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

3.03 INSTALLATION

A. Install in strict accordance with manufacturer's instructions and recommendations.

B. Over Steel Studs: Use hot-dipped galvanized self-tapping screws, with the points of at least three screws penetrating each stud the panel crosses and at panel ends.

C. Do not install siding less than 6 inches from ground surface, or closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.

D. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.

E. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

F. Align vertical joints of the planks over framing members.

G. Maintain clearance between siding and adjacent finished grade.

H. Locate splices at least one stud cavity away from window and door openings.

I. For proper fastener selection and fastening schedules for various wind load requirements and framing options, refer to the Technical Data Sheet at www.aspyredesign.com.

J. Face nail thru to sub-framing.

K. Locate splices at least 12 inches (305 mm) away from window and door openings.

L. Finish Painting: See Section .

M. Finish factory primed siding with a minimum of one coat of high-quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

3.04 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean faced panels in accordance with manufacturer’s maintenance instructions, using cleaning materials and methods acceptable to manufacturer.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 074646

SECTION 075400
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mechanically attached system with thermoplastic roofing membrane.

B. Insulation, flat and tapered.

C. Flashings.

D. Roofing stack boots and walkway pads.

1.02 SUMMARY

A. This Section specifies the construction of a mechanically fastened thermoplastic membrane roofing system (with contractor's option for either TPO or PVC), including but not limited to installation, membrane, polyisocyanurate insulation, adhesive, sealant, edge sealant, flashing, cleaner, walkway pads, fasteners, and testing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install the Roofing System work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein, whichever is more stringent. This work shall include but not be limited to design and procurement of the roofing membrane, related system materials, and associated reinforcing, cutting, sealing, gluing, fastening, cleaning, insulating, fitting and filling.

1.03 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking and nailers.

B. Section 077200 - Roof Accessories

1.04 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

B. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2021.

C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.

D. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2025.

E. NFPA 276 - Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components; Current Edition.

F. NRCA (RM) - The NRCA Roofing Manual; 2024.

G. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

H. UL 1256 - Fire Test of Roof Deck Constructions; Current Edition.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Submit required submittals within 30 days after contract award. Submittals shall be available at all times to the Owner's Construction Manager.

C. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

D. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
   1. Clearly show layout, designation, number, type, location and materials required.
   2. Must be submitted to roofing manufacturer for approval.
   3. Approved shop drawings are required for inspection of the roof and on projects where technical assistance is requested.
   4. Shall be approved and assigned a number by GAF Roofing Materials Corporation (or approved equal roofing manufacturer.)
   5. Shop drawings shall include:
      a. Outline of roof and size
      b. Location and type of all penetrations
      c. Perimeter and penetration details
      d. Membrane Sheet layout and sizes
      e. Number of Sure-Weld flashing roofs by width.
      f. Insulation manufacturer, brand and thickness
      g. Fastener manufacturer, brand and length
      h. Warranty type and period (20-year Golden Seal Warranty)
      i. Completely executed Notice of Award
      j. Deck type
   6. When project conditions require, authorized applicators are to supply GAF Roofing Materials Corp. with an as-built shop drawing. For inspection, as-built drawings must:
      a. Conform to most current published specifications and details at the time of installation.
      b. Be Approved and numbered by Manufacturer (GAF Roofing Materials Corporation).

E. Along with the project submittals (shop drawings and Request for Warranty), the roofing contractor must include pullout tests when:
   1. Fasteners are used in conjunction with Plywood decking less than 5/8" in thickness.

2. Fasteners are used in conjunction with Oriented Strand Board (OSB) decking. **OSB IS NOT TO BE USED ON HORIZONTAL APPLICATIONS.**

F. For all projects (prior to inspection by Manufacturer) a final Shop Drawing must be approved by Manufacturer.

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
1. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material and mill test reports, substantiating compliance with requirements.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Field quality control test and inspection reports.

K. Research/evaluation reports.

L. Maintenance data.

M. Warranty Documentation:
1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.
1. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein to provide a watertight/weathertight installation.

B. Installer Qualifications: Company specializing in performing work of this section with at least five years of documented experience.
1. Roofing System must be installed by a Manufacturer authorized roofing applicator to provide a watertight/weathertight complete installation.
2. Upon completion of the installation, an inspection shall be conducted by a technical representative of the roofing manufacturer to ascertain that the roofing system has been installed according to the System's most current published specifications and details.
3. There shall be no deviations made from this specification or the approved shop drawings without the **PRIOR WRITTEN APPROVAL** of the roofing system manufacturer listed above.
4. Roofing Systems Installer shall comply with all applicable Building Codes. The Installer shall verify and consult local jurisdictional codes for requirements, limitations, and restrictions.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer's instructions for installation shall be delivered and stored with the materials.

E. Testing and Inspections: As required by the latest industry codes and standards and / or the Manufacturer, whichever is the most restrictive.

F. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Exterior Fire-Test Exposure: Class A; ASTM E108, for application and roof slopes indicated.

G. Pre-installation Conference: Conduct on-site pre-installation conference. Attendees should include: General Contractor, Owner's Representative/Architect, Building Owner, Subcontractor, and Manufacturer's representative.

H. Tolerances shall conform to industry codes and standards, except as otherwise noted.

I. Single-Source Responsibility for Vegetated Roof Assemblies Over Waterproofing: Provide and install products from a single source.

J. **PRIOR TO THE USE OF ANY PRODUCT, CONSULT MANUFACTURER'S SAFETY DATA BULLETIN FOR APPLICABLE CAUTIONS AND WARNINGS.**

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.

B. Store materials in weather protected environment, clear of ground and moisture.

C. All materials, except membrane, shall be stored between 60 deg F and 80 deg F, and protected from water and direct sunlight.
   1. Keep all adhesives, sealants and cleaning materials away from all ignition sources.
   2. Do not store adhesive containers with opened lids.
   3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
   4. If exposed to lower temperatures, restore materials to 60 deg F minimum temperature, before using product on project.

D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

E. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 ROOF DECK CRITERIA (GENERAL)

A. Defects in the roof deck must be reported and, Documented to the Specifier, General Contractor and Building Owner for assessment.

B. Acceptable decks and applicable Manufacturer Fasteners:
   1. Steel- 22 Gauge or heavier: Manufacturer Fasteners/ SXHD Plates are required with minimum pull-out strength of 500 lbs per fastener.
   2. Lightweight Insulating Concrete, over steel: Manufacturer Fasteners/ SXHD Plates are required with minimum pull-out strength of 360 lbs per fastener (into steel decking below the Concrete).
   3. Structural Concrete- 3,000 PSI or greater: Manufacturer Drill-Tec Concrete Spikes or HD 14-10 Fasteners (with SXHD Plates) are required with a minimum pull-out strength of 800 lbs per fastener.
   4. Wood Plank or minimum 15/32 thick Plywood: Manufacturer Fasteners/ SXHD Plates are required with minimum pull-out strength of 360 lbs per fastener. If the minimum pull-out cannot be achieved in Plywood Decks, then the HD Woodie Fastener may be used, providing that the minimum pull-out strength of 360 lbs per fastener can be achieved.

C. Oriented Strand Board (OSB): Shall be an acceptable roof deck only when OSB has prior approval, in writing by roofing membrane manufacturer, and Roofing Installation Contractor, and only when specifically requested by Building Owner.
   1. When required by Building Owner, the OSB shall be an approved Weyerhaeuser or approved Potlatch Board. **No Substitutions**.
   2. OSB shall be rated to comply with ICC Legacy Report number NER-108 (latest published edition) and APA report PRP-108, shall be rated for exposure to the Exterior, Exposure I, and shall have a span rating equal to or better than the Plywood it replaces, with an equal thickness as plywood.

1.10 PRODUCT CONDITIONS

A. This system must not be applied on Projects where the roof slope exceeds 18” vertical in 12” horizontal, a 1.5 to 1 slope. When the slope exceeds 5” vertical in 12” horizontal, use of an automatic welding machine may be more difficult. A hand welder is recommended, and should be utilized.

B. Existing roofing material must be investigated by the specifier and all wet material must be removed.

C. Existing phenolic insulation and sprayed-in-place urethane roofs must be removed prior to installation of this roofing system.

D. Coordination between the trades is essential to avoid unnecessary traffic over sections of the roof system and to prevent damage to the membrane.

E. Cold Weather Requirements: See delivery and Storage requirements above.

F. Hot Weather Requirements: See delivery and Storage requirements above.

G. 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.

1.11 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years commencing upon the date of Substantial Completion.
   2. Manufacturer’s Warranty: Submit for Owner’s acceptance, manufacturer’s standard warranty document executed by an authorized Company Official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Additional requirements for Product Warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
   1. TPO: 60 mil thickness, single ply membrane reinforced with polyester scrim, mechanically attached. Subject to compliance with requirements, provide one of the following products:
   2. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle. (Approved Equal)
   3. Elevate; UltraPly TPO Membrane: www.holcimelevate.com.

4. GAF; EverGuard TPO 60 mil: www.gaf.com/#sle. (Basis of Design)
5. Johns Manville; JM TPO 60 mil: www.jm.com/#sle. (Approved Equal)

B. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials: (Contractor's Option)
1. Thermoplastic reinforced single ply membrane composed of polyvinyl chloride (PVC) sheet (Type II, Grade 1 or Type III), mechanically attached. Subject to compliance with requirements, provide one of the following products:
2. Carlisle SynTec Systems; Sure-Flex PVC KEE: www.carlisle-syntec.com/#sle.
3. Elevate; Elevate PVC Membrane: www.holcimelevate.com/#sle.
4. GAF; EverGuard PVC 60 mil: www.gaf.com/#sle.
5. Johns Manville; Ultragard System SR-60: www.jm.com/#sle.

C. Insulation:
1. Carlisle SynTec Systems; InsulBase: www.carlisle-syntec.com/#sle.
2. GAF; EnergyGuard Polyiso: www.gaf.com/#sle.
3. Johns Manville; E'NRGY 3 or ISO 3.
4. Products meeting the specified requirements by other manufacturers as recommended by the roofing membrane manufacturer..

2.02 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
1. Roof Membrane: Single ply reinforced membrane sheet as specified for the specific product hereinbefore and reinforced with polyester scrim conforming to ASTM D6878/D6878M.
2. PVC: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, Type II, sheet contains reinforcing fibers or reinforcing fabrics.
   a. Thickness: 60 mil, 0.060 inch, minimum.
3. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
   a. Thickness: 60 mil, 0.060 inch, minimum.
4. Sheet Width: 10’-0" wide field sheets (or 6'-6" max on PVC membranes)
   a. This system has 4'-0" or 5'-0" wide mechanically fastened perimeter sheets. Perimeter sheets are 5’-0" wide (when used with 10’-0" wide field sheets) or 4’-0" wide (when used with 8’-0" wide field sheets).
   b. Mechanically fastened field membrane sheets are either 8'-0" or 10'-0" wide (or 6’-6” maximum on PVC membranes.) depending upon wind load requirements or roof deck criteria. Membrane sheets shall be joined together by hot air welds.
5. Color: White.
6. Furnish and install Mechanically Fastened Roofing System in strict accordance with drawings and specifications as approved by Manufacturer.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.03 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289, as well as the thermal barrier requirements in either NFPA 276 or UL 1256.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 1, 16 psi (110 kPa), minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F.
            a) Reference required R-Value for roofing system as indicated on the Drawings.
   2. Board Size: 48 by 96 inches.
   3. Board Thickness: Thickness as needed for minimum 2-layers to achieve R-Value as indicated on the Drawings.

B. Roof Curb Insulation: Polyisocyanurate Foam; both faces covered with glass fiber felt; thickness to match wood nailer.

2.04 ACCESSORIES

A. Provide accessories as shown on the drawings and manufacturer’s system accessories for a complete and warranted Roofing System, including, but not limited to, the following flashing below.

B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Surface Color: White.

F. Edge Sealant: Cut Edge Sealant

G. Sealer: Water cut-off Mastic, and PT 304 Sealant

H. Pocket Sealant: Molded Pocket Sealant

I. Cleaner: Weathered Membrane Cleaner

J. Brite-Ply Splicing Cement

K. Membrane Cleaner

L. Pre-molded Inside / Outside Corners

M. Pipe Flashings and Sealant Pockets

N. Fasteners and Fastening Plates, as required by Manufacturer

O. Copings, Counterflashings, and other miscellaneous metal work not supplied by Manufacturer shall be furnished and installed as recommended by the Manufacturer to prevent Metal from pulling free, buckling, and sealed to prevent moisture from entering the Roofing System or Building.

2.05 FASTENERS

A. General: For all projects, a test installation with the proposed membrane underlayment and fastener is strongly recommended.

B. The Manufacturer's Fastener is required to have minimum pull-out strength of 360 lbs per fastener, unless noted otherwise within the Specifications. The thickness of insulation is limited to 1-1/2" when HD Woodie Fasteners are used. Where OSB deck is used (minimum 5/8" thickness), Manufacturer's Fasteners / SXHD plates may be used, providing the pull-out strength meets minimum strength requirements stated above.

C. The withdrawal resistance of fasteners will greatly depend on the physical condition of the respective deck and the type of fastener used.
   1. Due to the fluted design of most steel decks, a specific effort is required to ensure 3/4" deck penetration by every fastener. It is also recommended that the fasteners only be installed in the top flutes of the metal deck. Pre-construction / bid / installation investigation of deck alignment, physical conditions and rib depth shall be performed, along with the practice of making a test installation.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Applicators installing new Roof, Flashing, and Related Work shall be factory trained and approved by the Manufacturer they are representing.

B. All Work shall be of the highest quality and in strict accordance and compliance with the Manufacturer's written recommendations / Specifications.

C. The Roofing system shall be installed in accordance with approved Shop Drawings, and as approved by the Manufacturer.

D. When loading Material onto the roof, the Manufacturer Authorized Roofing Applicator must comply with the requirements of the Building Owner to prevent overloading and possible disturbance to the building structure.

E. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the Membrane System.

3.02 PRE-INSTALLATION CONFERENCE

A. Shall convene one week prior to commencing the Work of this Section.

B. Attendees to this meeting shall include the General Contractor, Architectural Representative, Building Owner, Roofing Sub-Contractor, and Materials Supplier.

C. The Conference is to confirm the Scope of work, and response of the various attendees.

D. The Roofing Contractor shall be responsible for all means and methods as they relate to safety, and shall comply with all applicable Local, State, and Federal requirements as they relate to Safety. Safety shall be the responsibility of the Roofing Contractor. All related personnel shall be instructed daily to be mindful of the full time requirements to maintain a safe environment for the facility's occupants including Staff, Visitors, Customers, and the occurrence of the General Public on or near the Project Site.

3.03 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.04 PREPARATION - METAL DECK

A. On retrofit- recover projects, cut and remove wet insulation, as identified by specifier, and fill all voids with new insulation, so that the new insulation is relatively flush with the existing surface.

B. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent the proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil, and grease. (For all Projects, substrate must be even without noticeable high spots or depressions, and must be free of accumulated water, ice or snow.)

C. Clear the substrate of debris and foreign material. Fresh bitumen based roof cement must be removed or concealed under new construction.

3.05 INSTALLATION, GENERAL

A. When feasible, Contractor shall begin the application at the highest point of the highest roof level and work to the lowest point to prevent moisture infiltration and to minimize construction traffic on completed Sections.

B. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

C. Do not apply roofing membrane during cold or wet weather conditions.

D. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

E. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

F. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

G. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

H. Refer to the applicable manufacturer's Material Safety Data Sheets (MSDS) and Technical Data Bulletins for applicable cautions, warnings and remedies.

3.06 INSTALLATION - INSULATION, UNDER MEMBRANE

A. General:
   1. For energy efficiency, multiple layers of insulation are used, and joints shall be staggered between layers, and in both directions.
   2. Only use Manufacturer’s supplied insulation material for this system. The performance or integrity of products by others is not covered by the Manufacturer Warranty.
   3. For all steel decking with ribs spaced wider than 1-3/4" apart, Contractor shall contact Manufacturer for approval.
   4. All insulation Board shall be butted together with no gaps greater than 1/4”. Gaps greater than 1/4” shall be filled with same and like material as insulation.
   5. On Remodeling Projects, or on projects with an existing roof, batt insulation suspended below the roof deck shall be installed. Thickness shall be as shown on Drawings.

B. Attachment of Insulation:
   1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions.
      a. For Polyisocyanurate less than 1-1/2” thick a minimum of 6 fasteners and plates per 4’-0" x 8’-0" board are required.
      b. Insulation Boards 4’-0" x 4’-0", regardless of thickness, must be fastened at the minimum rate of one (1) fastener and plate every four (4) SF.

c. Plates and fasteners shall be from one source. Piranha Plates or equal, Seam Fastening Plates (2” diameter) or Insulation Fastening Plates (3” diameter) must be used with appropriate Manufacturer Fastener for Insulation attachment. Mixing Plates from one manufacturer and Fasteners from another shall not be acceptable.

d. Steel- 22 Gauge or heavier: Manufacturer Fasteners/ SXHD Plates are required with minimum pull-out strength of 500 lbs per fastener.

C. Due to the fluted design of most steel decks, a specific effort is required to ensure 3/4" deck penetration by every fastener. It is also recommended that the fasteners only be installed in the top flutes of the metal deck. Pre-construction / bid / installation investigation of deck alignment, physical conditions and rib depth shall be performed, along with the practice of making a test installation.

D. Decking Material heavier than 22 gauge may require pre-drilling.

E. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. Do not install more insulation than can be covered with membrane in same day.

3.07 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Overlap edges and ends and seal seams by contact adhesive, minimum 5-1/2 inches and a minimum of 2" at end sections. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

D. At intersections with vertical surfaces:
1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
2. Fully adhere flexible flashing over membrane and up to nailing strips.

E. Around roof penetrations, seal flanges and flashings with flexible flashing.

F. Coordinate installation of roof drains and sumps and related flashings.

G. A minimum of one perimeter sheet shall be installed at edges of each roof level and either 10’-0" or 8’-0" wide membrane shall be installed in the field of the roof.

H. Membrane sheets shall be mechanically fastened with the appropriate Manufacturer Fastening/ Fastening Plate spaced 6” to 12” On Center, depending on project criteria, within the membrane splice. Refer to the “Design Criteria” section for required number of perimeter membrane sheets and fastener spacing.

I. Hot Air Weld the membrane sheets a minimum of 1-1/2” with an automatic Hot Air Welding Machine.

J. Membrane that has been exposed to the elements for approximately 7 days must be prepared with Membrane Cleaner, prior to seaming / welding.

K. Wipe the surface where Membrane Cleaner has been applied with a clean dry HP Splice Wipe or other white rag to remove any cleaner residue prior to hot air welding.

L. Apply Cut Edge Sealant on all cut edges of reinforced membrane in accordance with Manufacturer’s written recommendations / instructions.

M. The membrane must be secured at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any angle change which exceeds 2” in one horizontal foot and at all other penetrations in accordance with Manufacturer’s Details as published with Manufacturer’s Specifications.

3.08 MEMBRANE FLASHING

A. Flash all walls and curbs with reinforced membrane. Non-reinforced membrane shall be limited to inside and outside corners, field fabricated pipe seals, scuppers, and sealant pockets where the use of pre-molded accessories are not feasible.

B. Terminate the flashing in accordance with the appropriate Manufacturer Termination Detail. Use the longest pieces of material which are practicable.

C. On vertical surfaces, such as walls, curbs and pipes, bonding Adhesive is not required when the flashing height is 12” or less, and the membrane is terminated under a metal counterflashing (nailed).

D. When a coping or termination bar is used for vertical terminations, Bonding Adhesive may be eliminated for flashing heights of 18” or less.

3.09 ROOF DRAINS (Where indicated on the Drawings)

A. Prepare the substrate around roof drains to prevent membrane bridging or distortion and to provide a smooth transition from roof surfaces to drain clamping ring.

3.10 OTHER RELATED WORK

A. Heat Weldable Walkway Rolls are required when walkway pads are specified and are heat welded to the Roofing Membrane.

B. Interlocking Rubber Pavers, 24” x 24” x 2”, weighing approximately 6 lbs per SF, may be loose laid directly over the membrane. Installation instruction sheets are available from the Manufacturer.

C. Copings, Counterflashing and other metal work, not supplied by Manufacturer, shall be fastened to prevent the metal from pulling free or buckling. Metal work must be sealed to prevent moisture from entering the roofing system or the building.

D. Splash Blocks: Splash blocks shall be required beneath all downspouts which drain from a higher roof surface to a lower one.
   1. Pre-fabricated splashguards or concrete paver blocks are acceptable.
   2. Contractor shall use a protection board or slip sheet of reinforced membrane beneath the splash block for protection of the deck membrane.

3.11 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Immediately correct any identified defects in workmanship, or irregularities noticed as part of the installation.

3.12 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

E. Perform daily cleanup to collect all wrappings, empty containers, paper, and other debris from the project area / site. Upon completion, all debris must be disposed of in a legally approved / acceptable manner.

F. Remove bonding adhesive, bituminous markings and other contaminants from finished surfaces.

G. In areas where finished surfaces are soiled by asphalt or any source of soiling caused by the work of this section, consult Manufacturer of surfaces for cleaning advice and conform to those instructions.

H. Prior to the Manufacturer’s inspection for Warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking and sealants.

3.13 MAINTENANCE AND REPAIR DURING CONSTRUCTION

A. Maintain roofing system and related work from time of roofing completion until store Grand Opening. Repair material or installation defects or damage resulting from any subsequent work on the roof or from any weather-related damage. Maintain roof system in watertight condition including repair of conditions that show signs of inferior workmanship that may result in potential leaks. Repair leaks occurring prior to Grand Opening in accordance with good roofing practice and the requirements specified herein. Remove and replace wet insulation caused by water leaks and repair the roofing system.

B. Upon completion of the Roofing System, Contractor shall make arrangements for semi-annual inspection and maintenance.

3.14 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 075400

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SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants for joints within sheet metal fabrications.

1.02 SUMMARY

A. This Section specifies the construction of all flashing, sheet metal work, and related items including but not limited to installation, flashing, trim, fasteners, expansion joints, nails, welding rods, solder, caulk, sealants and roofing underlayment.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all flashing and sheet metal work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of flashing and sheet metal, associated soldering, welding, cutting, cleaning, fitting, mitering, fastening, and sealing.

C. Coordinate trade jurisdiction with respect to installing sheet metal items in conjunction with the roofing, and exterior wall finishes and cladding.

D. Related Requirements: Section 075400 “Thermoplastic Membrane Roofing” for installation procedures for roofing-related items.

E. Provide the sheet metal items in sufficient time to avoid delays to the construction progress.

F. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.

B. ASTM B32 - Standard Specification for Solder Metal; 2020.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2024).

E. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

F. NRCA (RM) - The NRCA Roofing Manual; 2024.

G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 CLOSEOUT SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Maintain one copy of each document on site.

C. 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, shop shall be listed as able to fabricate required details as tested and approved.

D. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
   1. Standards: Quality, Procedures and Methods Recommended by SMACNA (ASMM)'s "Architectural Sheet Metal Manual" and NRCA "Low Slope Roofing Manual" standard details and requirements.
   2. Investigate the requirements of the roofing manufacturer as related to sheet metal items. Quality and installation shall conform to the roofing manufacturer's requirements, to permit the issuance of the required guarantees.

E. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

F. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

G. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

H. Testing: As required by the latest industry codes and standards.

I. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. 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.

C. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

D. Additional requirements for product warranties are included in Section 016000.

1.07 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.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.
   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.

PART 2 PRODUCTS

2.01 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 (RM)'s "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA (ASMM)'s "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

2.02 FABRICATION

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. Form sections true to shape, accurate in size, square, and free from distortion or defects.
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

H. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

I. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
1. Use lapped expansion joints only where indicated on Drawings.
2. 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.

J. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

K. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

2.03 GUTTERS AND DOWNSPOUTS

A. Gutters: Profile as indicated.
1. Provide gutters in accordance with Figure 1-2, Style A.
2. Construct downspout-gutter connections in accordance with a secured and sealed joint, as shown in Figure 1-33D, of SMACNA (ASMM) Architectural Sheet Metal Manual (20 gauge minimum).

B. Downspouts: Profile as indicated.

1. Construct downspouts in accordance with Figure 1-32B, fully enclosed profile. of SMACNA (ASMM) Architectural Sheet Metal Manual and as detailed (22 ga. min.). Gutter straps shall be 18 ga. min.
2. Unless otherwise indicated on the drawings, provide downspout hangers in accordance with Figure 1-35D of SMACNA (ASMM) Architectural Sheet Metal Manual and as detailed.

C. Gutters and Downspouts: Size indicated on the Drawings.

D. Accessories: Profiled to suit gutters and downspouts.
1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
2. Gutter Supports: Brackets.
3. Downspout Supports: Brackets.

E. Downspout Extenders: Same material and finish as downspouts.

F. Seal metal joints.

2.04 THROUGH WALL SCUPPERS, CONDUCTOR HEADS

A. Provide galvanized metal scuppers and leader boxes, as indicated on the drawings or as specified herein.

B. Unless otherwise indicated on the drawings, construct scuppers and leader boxes in parapet walls in accordance with Figure 1-27-A and Figure 1-25C of SMACNA (ASMM) Architectural Sheet Metal Manual (24 ga. min.)

C. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

2.05 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.06 CURB MOUNTED REFRIGERATION LINE HOOD

A. Install galvanized sheet metal hood with gasketed fasteners at 8 inches on center and as indicated on Drawings. Seal all joints in hood and pipe penetrations to provide weatherproof enclosure.

2.07 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers. Furnish esposed fasteners as manufactured by the following:
1. Kwik-Pro Screws, by Hilti.
2. Trugrip GT, by ITW Buildex.

3. As recommended by the manufacturer.

B. Cleats: Same metal and gauge as sheets being anchored, 2" wide, punched for 2 anchors.

C. Underlayment: Self Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) 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.

D. Primer Type: Zinc chromate.

E. Concealed Sealants: Non-curing butyl sealant.

F. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

G. Plastic Cement: FS SS-C-153, Type I.

H. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

I. Reglets: Recessed type, galvanized steel.
1. As manufactured by Fry Reglet Corporation, Type MA, ST.

J. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering , High-Temperature Sheet Underlayment:
1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.

4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.04 INSTALLATION

A. Surfaces to receive sheet metal shall be clean, dry, and free from projections or other defects that would affect the application. Report any unsatisfactory surfaces to the Architect.

B. Where dissimilar materials abut, provide proper separation or protection to minimize the possibility of galvanic action.

C. Provide for thermal expansion of running trim, flashing, expansion joints, and other items exposed for more than 15'-0" continuous length.
1. Maintain a watertight installation at expansion seams.
2. Locate expansion seams as shown, or if not shown, at the following maximum spacing for each general flashing use:
a. Flashing, expansion joints, gravel stops, and trim: at 10'-0" intervals, and 24" on each side of corners and intersections.
b. Sealant-type expansion joints; where sealant-filled expansion joints are used, embed and hooked flanges of the joint members not less than 1.0" into the sealant.
1) Form joints to completely conceal the sealant.
2) When ambient temperature is moderate at the time of installation (40 deg to 70 deg F), set joint members for 50% movement either way.
3) Adjust setting proportionately for installation at higher ambient temperatures.
4) Do not install sealant type joints at temperatures below 40 deg F.
5) Installation of sealant is specified in Section 079200.

D. 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.

E. Opening: Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches.

F. Hem exposed edges to form a 1/2" wide hem on the side concealed from view.

G. Install sheet metal flashing and trim in accordance with applicable details of SMACNA (ASMM) "Architectural Sheet Metal Manual" and NRCA (RM) "Low Slope Roofing Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

H. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; seal flashings into reglets with sealant.
1. Provide watertight reglets in masonry or stucco to receive cap flashings.

I. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

J. Apply plastic cement compound between metal flashings and felt flashings.

K. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

L. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
1. Except where other methods of joining are indicated or specified, solder all joints, and connections of sheet metal work.
2. Remove grease and dirt from metal surfaces to be joined.
3. Remove all flux residue by scrubbing, neutralizing with ammonia, or a 5-10% solution of washing soda followed by a clear water rinse.
4. Assemble parts and solder using regular non-corrosive rosin flux.
5. Heat metal thoroughly to completely sweat solder through full contact area.

M. Secure gutters and downspouts in place with concealed fasteners.

N. Slope gutters 1/4 inch per 10 feet, minimum.

O. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.05 COUNTERFLASHING

A. Provide metal counterflashing at top edges of built-up base flashings and at other location indicated.

B. Form flashing in 8'-0" or 10'-0" lengths, except where shorter pieces are required.

C. Lap end joints a minimum of 3".
1. Do not solder or weld joints.
2. Make flashing continuous at angles.
3. Counterflashing shall overlap base flashing a minimum of 4" unless otherwise indicated.

D. Where counterflashing terminates in reglets, fasten flashing with lead wedges every 12".
1. Fill reglets continuously with sealant compound.
2. Sealing compound shall be synthetic rubber type as specified herein.

E. Where prefabricated counterflashing and reglet system is used, form the upper edge of counterflashing with an approved snap lock flange to engage the reglet receiver and to provide a spring action at bottom edge against the built-up flashing.

3.06 PARAPET CAP FLASHING

A. Install pre-finished sheet metal coping with continuous cleat in accordance with SMACNA requirements, profiles as indicated and on the Drawings.

1. Set cleat in full bed of sealant, overlaying and concealing continuous parapet waterproofing membrane.
2. Secure cleat to nailer at 6 inches on center.

B. Install coping in accordance with SMACNA (ASMM) Figure 3-1 over shaped fiber board; secure roof side edge using washered screws in staggered pattern through slotted or oversized holes located at maximum 12" on-center.

C. Provide coping in minimum 10 to maximum 25 foot lengths.

D. Provide thermal expansion joints using joints in accordance with SMACNA (ASMM) Figure 3-3, Covered Plate Seam. Set lap in beds of sealant.

3.07 METAL EDGINGS

A. Provide metal edgings at exposed edges of built-up roofs.

B. Fabricate from 24 gauge galvanized iron, profile as indicated on the drawings.

C. Form in 8'-0" or 10'-0" units.
1. Form corner sections by mitering and spot welding or riveting the flange and seal with sealant.
2. Form expansion joints between units with 6" wide back-up plate and cover plates formed to exact profile of gravel stop.
3. Fill space between units and plates with sealant.

D. Extend flanges of metal edges out on top of built-up roofing not less than 4".
1. Set in full bed of plastic cement.
2. Spread full bed of plastic cement between sheets at laps.
3. Nail 1" from back edge at 6" o.c. into wood nailer.
4. Use neoprene washers on nails.

3.08 EQUIPMENT SUPPORT FLASHING (Pitch Pans / Pitch Pockets)

A. The use of a pitch pan may be used to flash a small penetration through roofing where it is impossible to use any other type of flashing.

B. Coordinate installation of equipment support flashing with installation of roofing and equipment.

C. Pitch pans shall be fabricated and installed in accordance with the latest SMACNA (ASMM) Architectural Sheet Metal Manual and as specified herein.
1. The flanges extend a minimum of 4" onto the roof, and are fastened over the roofing felts.
2. Flashing shall be installed around roof penetration in a square or rectangular shape. Pitch pan should be 2" longer, and 2" wider than the support it is flashing.
3. The flange is stripped in by the roofer.
4. Sides extend a minimum of 4" above the roof.
5. All joints shall be seamed and sealed.

D. Weld or seal flashing with butyl sealant to equipment support member.

E. Pitch pan shall be filled by the roofer. Fill bottom of pan to a depth of 1" with asphaltic plastic cement. Fill remainder of pan flush with the top with pitch.

F. Bonnet flashing should be used to cover a pitch pan.

G. Pitch pans require maintenance.

3.09 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.10 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.

3.11 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 076200

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hatches with access ladders.

B. Safety Railing System

1.02 SUMMARY

A. This Section specifies the construction of all roof hatch assemblies including installation, roof curbs, covers, flanges, fasteners, insulation, safety posts, and finishing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all roof hatch assemblies, as indicated on the Drawings or as specified herein. This work shall include but not be limited to design and fabrication of roof hatches, and associated welding, reinforcing, support of other work, cutting, insulating, fitting, fastening, cleaning and priming.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2024).

E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.

3. Installation methods.
4. Product description, dimensions, finishes.
5. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
1. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

D. Closeout submittal: Installer's certification that snow guard system was installed in accordance with manufacturer's instructions and approved Shop Drawings.

E. Warranty Documentation:
1. Submit manufacturer warranty.
2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.
1. Sheet Metal Standard: Comply with SMACNA (ASMM)’s “Architectural Sheet Metal Manual” details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Testing: As required by the latest industry codes and standards.

E. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Manufacturer Warranty: Provide 2-year manufacturer warranty from date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
1. Babcock-Davis; Personnel II (Ladder Access): Model BG3620, galvanized, www.babcockdavis.com/#sle.
2. Bilco Company; Type S-20, www.bilco.com/#sle.
3. This specification is based on the above products. Products equaling or exceeding this specification as manufactured by Babcock-Davis Associates, Inc., or Inland Steel Products Company are acceptable..
4. Substitutions: See Section 016000 - Product Requirements.

B. Roof Hatches: Factory-assembled galvanized steel frame and cover, complete with operating and release hardware.
1. Size: As indicated on drawings; single-leaf style unless otherwise indicated.
2. Insulation on exterior of the curb shall be 1" thick rigid fiberboard.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Material: Galvanized steel, 14 gauge, 0.0747 inch thick.
2. Finish: Factory prime paint.
3. Equip curb with an integral metal cap flashing of the same gauge and material as the curb, full welded at the corners for absolute weather tightness.
4. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb and protected by a galvanized steel, prime painted, 22-gauge metal liner.

D. Metal Covers: Flush, insulated, hollow metal construction.
1. Capable of supporting 40 psf live load.
2. Material: Galvanized steel; outer cover 14 gauge, 0.0747 inch thick, liner 22 gauge, 0.03 inch thick.
3. Finish: Factory prime paint.
4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
5. Gasket: Neoprene, continuous around cover perimeter.

E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Heavy duty pintle type.

3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.

F. Safety Posts:
1. Bilco LadderUp Safety Post LU-1 at roof hatch, one posts shall be required.
2. **Option**: Hatch-Grip by PS Doors, Grand Forks, ND (800) 284-0623

G. Wood Nailers: Softwood lumber, pressure treated with water-borne preservatives for above ground use, complying with AWPBLP-2; match roofing insulation total thickness.

H. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal.

I. Gaskets: Tubular or fingered design of neoprene or polyvinyl chloride, or block design of sponge neoprene.

J. Bituminous Coating: FS TT-C-494 or SSPC-Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coating.

K. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.

L. Elastomeric Sealant: Generic type recommended by unit manufacturer, which is compatible with joint surfaces, comply with FS TT-S-0027, TT-S-00230, or TT-S-001543.

M. Roofing Cement: ASTM D4586/D4586M, asphaltic.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

B. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
1. Railing Size: As indicated on drawings.
2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with safety factor of two.
3. Posts and Rails: Galvanized steel tubing.
4. Products:
a. BILCO Company; Bil-Guard 2.0, Model #RL2-S: www.bilco.com/#sle.

b. Safety Rail Company; Standard Roof Hatch Safety Railing Model #RHSR-SS-3630: www.safetyrailcompany.com/#sle.
c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

B. Furnish mechanical fasteners consistent with the roof requirements.

C. Coordinate installation of roof accessories with installation of deck, insulation, flashing, roofing membranes, penetrations, other equipment, and construction involving roof accessories to ensure that the combined elements are waterproof and weathertight. Anchor roof accessories securely so they are capable of withstanding lateral, thermal, inward, and outward pressures.

D. Install roof accessory items according to construction details of NRCA’s “Roofing and Waterproofing Manual,” unless otherwise indicated.

E. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

F. Test unit operations for proper performance of operable components. Clean, lubricate and adjust joints and hardware.

G. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

H. Install roof accessories to fit substrates and to result in watertight performance.

I. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

J. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.

K. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

L. Seal joints with sealant as required by manufacturer of roof accessories.

3.04 CLEANING

A. Clean installed work to like-new condition.

B. Clean surfaces according to manufacturer’s written instructions. Repair all damaged coatings.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

SECTION 079100
PREFORMED JOINT SEALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precompressed foam seals.

1.02 QUALITY ASSURANCE

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

1.03 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealers that fail to achieve watertight seal or exhibit loss of adhesion or cohesion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Precompressed Foam Seals:
   1. EMSEAL Joint Systems, Ltd; Colorseal: 108 Milk St., Suite 3, Westborough, MA 01581, Tel: (800) 526-8365 or (508) 836-0280. (Local Representative: 21 Tech Company, 1121 W. Honeysuckle Lane, Chandler, AZ 85248, Attn: Tony Valdez, Phone: (480) 812-8800, www.emseal.com/#sle.
      a. Colorseal: Cured silicone factory bellows facing on “greyflex water-based acrylic impregnated expanding polyurethane foam anchoring system”.

2.02 PRECOMPRESSED FOAM SEALS

A. Precompressed Foam Seal: Comprised of urethane, modified-acrylic impregnated, open-cell polyurethane, or closed-cell neoprene foam impregnated with water-repellent, and with self-adhesive faces protected prior to installation by release paper.
   1. Color: To match adjacent material color.
   2. Size as required to provide weathertight seal when installed.
   3. Calculate size according to manufacturer's recommendations.
   4. Measure size of existing joints before selecting seal width.

5. Applications:
   a. Exterior wall expansion joints.
6. Products:
   a. EMSEAL Joint Systems, Ltd; Seismic Colorseal: www.emseal.com/#sle.

2.03 ACCESSORIES

A. Adhesive: As recommended by seal manufacturer.

B. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and strip seal.

C. Substrate Cleaner: Non-corrosive, non-staining type recommended by seal manufacturer; compatible with joint forming materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive this work.

B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

3.02 PREPARATION

A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Precompressed Foam Seals:
   1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
   2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
   3. Remove loose materials and foreign matter that could impair adhesion of sealant.
   4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect joints from damage until adhesives have properly cured.

END OF SECTION 079100

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SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 SUMMARY

A. This Section specifies the furnishing and installation of all caulking, general sealants, joint closures, and related materials including acrylic latex based, silicone based, non-elastomeric 2-component polyurethane based, back-up material and joint filler, primer, polyethylene tape, solvents, and cleaning agents.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish and install all sealant and joint work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to cleaning, caulking, sealing, tooling, taping, and priming.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 079100 - Preformed Joint Seals: Precompressed foam, gaskets, and strip seals.

1.04 REFERENCE STANDARDS

A. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.05 ENVIRONMENTAL REQUIREMENTS

A. Minimize dust emissions and provide equipment that suppresses dust.

1.06 QUALITY ASSURANCE

A. Comply with the latest local codes and standards, and the requirements of ASTM C920, ACI SPEC-301, ACI 302, ASTM C1193, and ASTM C1330 as applicable.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   1. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance, and approved by sealant manufacturer if required.

D. Certification: Product certificates and test reports, signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. Testing: As required by the latest industry codes and standards.

H. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

D. Guarantee shall be issued jointly by the General Contractor and applicators from the date of Certificate of Occupancy.

E. Additional requirements for product warranties are included in Section 016000.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage, and handling in Section 016000.

1.09 PROJECT CONDITIONS

A. Cold Weather Requirements: Do not apply sealants in temperatures or to material below 40 degrees F.

B. Clean joints before installation.

C. Caulk joints before final coat of paint or before application of any clear or stain waterproofing compounds.

D. Do not apply sealants to surfaces that are wet.

1.10 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

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

C. Compatibility and adhesion test reports.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Do Not Seal:

a. Intentional weep holes in masonry.
b. Joints indicated to be covered with expansion joint cover assemblies.
c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
d. Joints where sealant installation is specified in other sections.
e. Joints between suspended ceilings and walls.

B. Exterior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane traffic-grade sealant.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Nonsag silicone sealant for continuous liquid immersion.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content.

B. Interior Sealants:
1. All sealant used on interior of project are to be acrylic latex base unless noted otherwise.
2. Sealant shall be acrylic latex base conforming to ASTM C834.

C. Exterior Sealants:
1. All sealants used on exterior of project are to be 2-component polyurethane base, including inside surface of exterior joints.
2. Elastomeric Joint Sealant shall be 2-component base of liquid (or paste equal) polyurethane.
3. Sealant shall either match adjacent surface or be as selected by the Architect.
4. Sealants shall conform to the following:
a. Traffic Joints: ASTM C920, Type M, Grade P, Class 25, Use T (Fast Drying)
b. Horizontal Joints: ASTM C920, Type M, Grade P, Class 25, Use T (Fast Drying)
c. Other Joints: ASTM C920, Type M, Grade NS, Class 25, Use NT, M, A, or O

D. Roofing (Sheet Metal Flashings and Trim:
1. ASTM C920, Type M, Grade NS, Class 25, Use NT, M, A, O.
2. As recommended by Roofing Manufacturer

E. Sealant Color:
1. In interior and exterior exposed areas, match color of adjacent paint color finish or other adjacent finish color if proprietary color is not otherwise specified herein.

2. In joints where plumbing fixtures meet adjacent floor and wall finishes, match color of plumbing fixture.
3. Use clear, colorless sealant where applied to stainless steel surfaces.

2.03 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
2. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
3. Color: Clear.
4. Products:
a. Dow; DOWSIL 786 Silicone Sealant: www.dow.com/#sle
b. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
d. Pecora Corporation; Pecora 864 NST (Non-Staining Technology): www.pecora.com/#sle.
e. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
f. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com/#sle.
g. Tremco Commercial Sealants & Waterproofing; Spectrem 3: www.tremcosealants.com/#sle.
h. Tremco Commercial Sealants & Waterproofing; Tremsil 200: www.tremcosealants.com/#sle.
i. MasterSeal NP 150 by BASF - Sonneborn.
j. SilPruf SCS2000 (Non-USDA) by GE.
k. Titebond 100% Silicone Sealant by Franklin International.
l. Sanitary SCS1700 (Non-USDA) by GE.

B. Silicone Sealant: ASTM C920, Grade NS, Use T; single component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Location: Exterior Sidewalk and pavement joint materials.
2. Products:
a. Dow; DOWSIL 888 Silicone Joint Sealant: www.dow.com/#sle.
b. Pecora Corporation; Pecora 301 NS (Non-Sag): www.pecora.com/#sle.
c. Tremco Commercial Sealants & Waterproofing; Spectrem 800: www.tremcosealants.com/#sle.

C. Polyurethane Sealant: ASTM C920, Grade NS, Class 50, Uses M and A; multi-component; not expected to withstand continuous water immersion or traffic.
1. Sealant around each interior column at the color slab only.
2. Color: To be selected by Architect from manufacturer's standard range.
a. Dried color to match adjacent polyuria joint filler material.

3. Products:
    a. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
    b. BASF / Sonneborn; MasterSeal NP 2.

D. Nonsag Traffic-Grade Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Color: Match adjacent finished surfaces.

E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's standard range.

2.04 SELF-LEVELING JOINT SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.

B. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
2. Color: Match adjacent finished surfaces.
3. Products:
    a. Euclid Chemical Company; EUCO QWIK Joint 200: www.euclidchemical.com/#sle.

2.05 ACCESSORIES

A. Sealant Backing Rod, Closed-Cell Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25-33 percent larger in diameter than joint width.

B. Sealant Backing Rod, Bi-Cellular Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type B.
2. Products:
    a. Ceramar Flexible Foam Expansion Joint, by W.R. Meadows.
    b. Deck-O-Foam Expansion Joint Filler, by W.R. Meadows.

C. Soft Preformed Joint Filler: Flexible closed-cell non-extruding synthetic foam expansion joint strips.
1. Ceramar Flexible FoamExpansion Joint, by W.R. Meadows.
2. Deck-O-Foam Expansion Joint Filler, by W.R. Meadows

D. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

E. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. General: Qualified applicators (5 year minimum successful experience in application of joint sealers specified) shall apply sealants in conformance with manufacturer's written directions. Some products must be applied by one of the Sealant Manufacturer’s Approved Applicators.

3.02 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Examine all surfaces and report all conditions not acceptable.

3.03 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
   1. Thoroughly clean all joints, removing all foreign matter such as dust, oil, grease, water, surface dirt and frost. Sealant must be applied to the base surface. Previously applied paint or primer must be entirely removed.
   2. Porous materials such as concrete or masonry shall be cleaned where necessary by grinding, blast-cleaning, mechanical abrading, acid washing to combination of these methods to provide a clean, sound base surface for sealant adhesion.
   3. Laitance shall be removed by acid washing, grinding or mechanical abrading.
   4. Form oils shall be removed by blast cleaning.
   5. Lose articles present or resulting from grinding, abrading or blast cleaning shall be removed by blowing out joints with oil-free compressed air (or vacuuming) prior to application of primer or sealant.
   6. Non-porous surface, such as metal and glass, shall be cleaned either mechanically or chemically. Protective coatings on metallic surfaces shall be removed by a solvent that leaves no residue. Solvent shall be used with clean cloths or lintless paper towels. Do not allow solvent to air dry without wiping. Wipe dry with clean, dry cloth or lintless paper towels.
   7. Joint areas to be protected with masking tape or strippable films shall be cleaned before application of tape or film.

8. All joints to receive sealant shall be as indicated on Shop or Project Drawings. Do not seal joints until they are in compliance with Drawings or meet with the approval of the Architect.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
1. Apply masking tape, where required, in continuous strips in alignment with joint edge.

E. Unless otherwise indicated, for joints in concrete or masonry: depth of the sealant may be equal to the width in joints up to 1/4" wide. For joints 1/2" to 1" wide: depth shall be 1/2". For expansion and other joints 1" to 2" wide: depth shall not be greater than half the applied sealant width. For joints exceeding 2" in width: depth shall be as directed by sealant manufacturer.

F. For joints in metal, glass and other non-porous surfaces: sealant depth shall be a minimum of half the applied sealant width, and shall in no case exceed the applied sealant width.

G. Joints to receive sealant, back-up material or pre-formed joint filler shall be cleaned out, raked to full width and depth as required.

H. Joints shall be of sufficient width and depth to accommodate specified back-up material or preformed joint filler and sealant.

I. Prime surfaces, where required, with primer as recommended by sealant manufacturer.

3.04 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Follow sealant manufacturer's instructions regarding mixing (if required), surface preparation, priming, application life, and application procedure.

C. Provide joint sealant installations complying with ASTM C1193.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install back-up material or joint filler of type and size specified, at proper depth to provide sealant dimensions as detailed.
1. Back-up material shall be of suitable size and shape; and compressed 25-50% to fit joints as required.
2. Sealant shall not be applied without back-up material and/or bond breaker strip.
3. When using back-up tube, avoid lengthwise stretching.
4. Tube or rod shall not be twisted or braided.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

J. Apply sealant under pressure with hand or power actuated gun or other appropriate means. Gun shall have nozzle of proper size and provide sufficient pressure to completely fill joints as designed. All joint surfaces shall be tooled to provide the contour as indicated.

K. When tooling sealants, use tooling solution recommended by sealant manufacturer. Remove masking tape immediately after joints have been tooled.

L. Clean adjacent surfaces of sealant as work progresses. Use solvent or cleaning agent as recommended by sealant manufacturer. All finished work shall be left in a neat, clean condition.

3.05 SEMI-RIGID JOINT FILLER

A. Contractor performing the installation must be one of the Manufacturer’s Approved Applicators.

B. Comply with recommendations of ACI 302 for use of joint fillers as applicable to the materials, and conditions indicated. Do not use joint sealant backing if not recommended by manufacturer.
1. Joints must be clean and dry.
2. Remove all materials that may inhibit proper bonding.
3. Follow manufacturer’s written instructions for installation of individual materials for each application.

3.06 JOINT CLOSURE INSTALLATION

A. Qualified applicators (five (5) years minimum successful experience in application of joint closures specified). Install closures in conformance with manufacturer's written directions.

B. Examine all surfaces and report all conditions not acceptable.

C. Preparation:
1. Thoroughly clean all joints, removing all foreign matter such as dust, oil, grease, water, surface dirt and frost. Closure must be applied to the base surface. Previously applied paint or primer must be entirely removed.
2. Porous materials such as concrete or masonry shall be cleaned where necessary by grinding, blast-cleaning, mechanical abrading, acid washing to combination of these methods to provide a clean, sound base surface for sealant adhesion.
3. Laitance shall be removed by acid washing, grinding or mechanical abrading.
4. Form oils shall be removed by blast cleaning.

5. Lose articles present or resulting from grinding, abrading or blast cleaning shall be removed by blowing out joints with oil-free compressed air (or vacuuming) prior to application of closure.
6. Non-porous surface, such as metal and glass, shall be cleaned either mechanically or chemically. Protective coatings on metallic surfaces shall be removed by a solvent that leaves no residue. Solvent shall be used with clean cloths or lintless paper towels. Do not allow solvent to air dry without wiping. Wipe dry with clean, dry cloth or lintless paper towels.
7. NOTE: Unpainted metal and natural stone surfaces may require priming. See manufacturer's recommendations.
8. Joint areas to be protected with masking tape or strippable films shall be cleaned before application of tape or film.

D. All joints to receive closure shall be as indicated on Shop or Project Drawings.

E. Application:
1. See manufacturer's recommendations for joint closure size based on joint size. Follow manufacturer's recommendations for closure installation.

F. General Applications:
1. Ensure material nominal size matches joint size.
2. Remove shrink-wrap packaging, hardboard, and self-adhesive release paper.
3. Wipe factory-applied release agent off silicone facing using clean, lint-free rag made damp with toluene.
4. Apply thin bead of silicone sealant along edge of bellows at end where the material will join with next length.
5. Insert material into joint with at least a 1/4" (6mm) recess and adhere to one side. Material expands to contact other side of joint-gap. (Wedge larger sized material in place while it expands).
6. Bend silicone at joints into the silicone bellows to create a consistent finished appearance being sure not to restrict the folds of the bellows.
7. Once material has equalized its expansion across the joint, gun and tool a 1/4" x 1/4" (4mm x 4mm) corner bead at the substrate-to-bellows interface.
8. Clean adjacent surfaces of sealant as work progresses.

G. Use solvent or cleaning agent as recommended by closure manufacturer.

H. All finished work shall be left in a neat, clean condition.

3.07 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.08 SCHEDULE

A. CAULKING
1. Provide caulking at the following locations. This schedule is not to be construed to be complete. Provide caulking at other areas as required to provide a watertight building.
a. Control joints in masonry surfaces, interior and exterior.
b. Control joints and expansion in concrete surfaces, interior and exterior.
c. Perimeter of door frames, interior and exterior.
d. Perimeter of window frames, interior and exterior.
e. Perimeter of louvers and grilles, interior and exterior.
f. Perimeter of aluminum sections, interior and exterior.
g. Top edge of all reglet/counterflashing assemblies.

B. At interior partitions caulking is required at all joints between dissimilar materials where the joint width exceed 1/16".

C. SANITARY CAULKING
1. Caulk all joints, seams, cracks, etc., mech., janitor, and toilets.
2. Typical joints to be caulked are as follows:
a. Juncture of all wall panels with floor or base.
b. Juncture of door jambs or jamb covers with walls.
c. Juncture of fixture with floor and wall.
d. Around plumbing fixtures.
e. All other similar locations.

D. Sanitary caulking shall be completed in a neat and careful manner, suitable to receive approval of Health Department.

E. General Contractor shall be responsible for acceptance of all caulking under this division by the Health Department.

F. All caulking shall receive a written five (5) year guarantee.

END OF SECTION 079200

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SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Thermally insulated hollow metal doors with frames.

1.02 SUMMARY

A. This Section specifies the construction of all hollow metal doors and metal frame assemblies including installation, clips, shims, hinges, reinforcement, hardware, paint, and finishing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all hollow metal frame and door work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of door frames and associated welding, anchoring, aligning, inspecting, reinforcing, cutting, fitting, cleaning and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2022.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.

O. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

Q. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material and mill test reports, substantiating compliance with requirements.

E. Welding Certificates

F. Field quality control test and inspection reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
   1. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Maintain at project site copies of reference standards relating to installation of products specified.

C. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein. All doors and frames shall meet specified requirements and SDI-100 for unit welded frames and doors, and the NAAMM "HMMA 810-850".

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: As required by the latest industry codes and standards.

G. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.07 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

C. Transport, handle, and store, doors and frames in accordance with manufacturer’s written instructions. Store materials in a vertical position, covered and placed on 4” wood sills in a manner to prevent rust, moisture damage, and damage from ongoing construction activities.

D. Provide wood slats between doors to avoid any metal-to-metal contact. Leave doors in stored position until ready to hang.

E. Identify each door and frame per shop drawings.

F. Opening Force Requirements:
   1. Accessible Doors: Not more than 5 lbf.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. General:
   1. Construction:
      a. Vertical stiffeners shall be 22 gauge steel "U" forms, spot welded to each inside face of the door full height and not more than 6" apart.
      b. Reinforce top and bottom of doors horizontally by steel channels, full width spot welded to each face at least 4" O.C. Joints at the edges of doors shall be continuously welded automatically by the gas shielded method arc process.
      c. Arc welding and filling seams are not acceptable.
   2. Provide double doors with one-piece astragals of 12-gauge steel.
   3. Provide solid drip cap at top of all exterior out-swinging doors.
   4. Accurately mortise doors for locks and hinges. Provide adequate reinforcement in accordance with Table IV SDI-100 and NAAMM CHM-1.
   5. Provide louver doors as scheduled.
      a. Provide sight proof louvers either pierced into the panels of the doors or inserted into the panels.
      b. Form louver frames of minimum 20-gauge steel.
      c. Weld or tenon minimum 24-gauge blades to frame and fasten the entire assembly to the door with moldings.
      d. The moldings, when used, shall be an integral part of the louver.
   6. Provide for glazing in doors as scheduled:

a. Non-removable minimum 20-gauge glazing stops shall occur on the outside of exterior doors and on the reverse side of interior doors.
b. Glazing beads on the inside of glass panels shall be removable.

7. Provide doors with UL labels as required or indicated.
8. Knob mounting height 38" A.F.F. (see Section 087100 for exterior handles or knobs).

C. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 2 - Heavy-duty.
b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
b. U-value of 0.39.
3. Door Thickness: 1-3/4 inches, nominal.

D. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 1 - Standard-duty.
b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
a. Doors shall have inorganic sound deadening material non-combustible batt-type applied to the interior surface of panels. Sound deadening shall eliminate all metallic reverberations incidental to normal door operation.
3. Door Thickness: 1-3/4 inches, nominal.

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frames shall be pressed steel to profile indicated on the Drawings, 16-gauge (unless otherwise noted) cold rolled, pickled, annealed steel, unit type welded construction, with angles, modes, returns and miters neatly welded and weld beads ground smooth.

C. Exterior Door Frames: Knock-down type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
2. Weatherstripping: Separate, see Section 087100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
   2. Frame Finish: Factory primed and field finished.

E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

F. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

G. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

H. Prepare frames to receive mortised type hardware.
   1. Spot-weld reinforcing plates to inner surface of jambs at hinge, lock, latch, and other hardware locations. Hinge reinforcements shall be 10-gauge steel for lightweight core doors, 7-gauge steel for others.
   2. All other hardware reinforcements shall conform to SDI-100.
   3. Spot-weld 24-gauge galvanized steel plaster guards over hardware from templates furnished to frame manufacturer by hardware supplier.
   4. Provide suitable reinforcements for surface applied hardware.
   5. Punch door stops to receive rubber silencers as required.

I. Provide frames with fixed insert anchors welded to face and flange returns 12" down from top, then 24" on center.
   1. Provide frames with minimum 14-gauge floor clips welded to each jamb, face and flanges punched for anchoring to floor.
   2. All anchors to be suitable for wall conditions.
   3. At door openings wider than 42" and at multiple openings, reinforce head members full length with 12-gauge steel channel.
   4. Brace door frames with temporary wood or metal spreaders to insure maintaining square and true shapes in shipping.
   5. Frames or doors damaged in any way shall not be installed.

J. Provide frames with loose glazing beads with screws for flush countersunk installation to receive glass per SDI-100.

K. Priming for Frames:
   1. Frames to receive one shop coat of light gray zinc chromate rust inhibitive primer, baked on.
   2. Primer shall be smooth surface, ready to receive finish coats at time of delivery and when installed.
      a. No runs, overspray, dust or other defects will be allowed.
      b. Primer shall be bonded to metal sufficiently that upon aging it will not chip or flake when scraped through.

2.04 FINISHES

A. Doors to be thoroughly cleaned, bonderized and primed with shop coat of light gray zinc chromate rust inhibitive primer, baked on.

B. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

C. Primer shall be smooth surface, ready to receive finish coats at time of delivery and when installed. No runs, overspray, dust or other defects will be allowed. Primer shall be bonded to the metal sufficiently that upon aging it will not chip or flake when scraped through.

2.05 ACCESSORIES

A. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

D. Moldings for Glazed Lites in Doors: Minimum 0.032" (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

E. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8" (16 mm) high, unless otherwise indicated.

F. Loose Stops for Glazed Lites in Frames: Minimum 0.032" (0.8 mm) thick, fabricated from same material as frames in which they are installed.

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall install steel doors, frames, finish hardware and appurtenances provided by the Owner plumb, rigid, properly aligned, securely fastened in place, and as indicated on the Drawings, as specified herein, and in accordance with manufacturer's written instructions.

B. Where required by local codes, at fire-protection-rated openings, install doors and frames according to NFPA 80.

C. Where required by local codes, install smoke control doors in accordance with NFPA 105.

D. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Section 042000 - Unit Masonry.

E. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.

3.02 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.03 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.04 INSTALLATION (GENERAL)

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 087100.

3.05 FRAME INSTALLATION

A. In concrete walls, provide adjustable T-strap type anchors, of not less than 16-gauge steel or 0.156" diameter steel wire.
   1. Provide a minimum of four anchors per jamb for frames up to 8'-0" in height.
   2. For frames over 8'-0", provide one additional anchor for each 2'-0" or fraction thereof in height.

B. Frames in drywall partitions shall be equipped with anchors for both attachments through studs.
   1. Provide a minimum of 4 anchors at each jamb up to 9'-0" height fabricated from 18-gauge steel.
   2. Anchors shall be welded in the frame.

C. At each jamb of frames in masonry walls, provide at least three (3) "T" type loose masonry anchors fabricated from 18-gauge steel up to 8'-0" high.

D. Floor anchor clips shall be fabricated from 14-gauge steel and shall be welded between the door frame flanges.
   1. Anchor clips to floor with at least two power driven anchors or equivalent per clip to prevent twist

3.06 FRAME INSPECTION

A. Installer must examine substrates and conditions under which metal door and frames are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.07 PLACING FRAMES

A. Install metal doors, frames, and accessories in accordance with approved shop drawings, manufacturer's data, and as specified herein

B. Except for frames located at in-place concrete or masonry and at drywall installations, place frames prior to construction of enclosing walls and ceilings.

C. Set frames accurately in position, plumb, aligned, and braced securely until permanent anchors are set.

D. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

E. Caulk frames to floor, typical.

3.08 DOOR INSTALLATION

A. Fit hollow metal doors accurately in frames with clearances as follows:
1. Between door and frame at head and jamb: 1/8"
2. At door sill without threshold: 3/8" max.
3. At door sill with threshold: 1/4" max.
4. Between meet edges of pairs of doors: 1/8"

B. Note: No hardware is to be visible on hollow metal doors at building exterior.

C. Place fire-rated doors with clearance as specified in NFPA 80.

D. Install doors completely and accurately, complete with all finish hardware. Install finish hardware in a neat workmanlike manner in accordance with the hardware schedule using only mechanics skilled in this type of work.
1. Do not install hardware until painting is completed.
2. Keep all hardware free from scratches, dents or other defacements.

E. Adjust and Clean:
1. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
2. Final Adjustments: Check and re-adjust operating finish hardware items, leaving metal doors and frames undamaged and in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

F. Glazing: Comply with installation requirements in Section 088000 - Glazing and with standard steel door and frame manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

B. Section 087100 - Door Hardware.

C. Section 088000 - Glazing.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

C. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

C. All materials and systems shall fully comply with ADAAG.

D. Comply with requirements of the ANSI/WDMA I.S. 1A-13 Interior Architectural Wood Flush Doors".

E. Conform to requirements of AWI Quality Standards Section 1300, Architectural Flush Doors.

F. Installed Doors: Conform to NFPA 80 for fire rated class indicated where required by Code.

G. All doors shall be provided by the same manufacturer to ensure uniformity of quality and appearance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

D. Do not deliver wood doors to jobsite until weatherproof storage is available. Store doors in a space having controlled temperature and a relative humidity between 30 - 60%. Protect doors from direct exposure to sunlight.

E. Stack doors flat, off the floor and supported to prevent warpage. Do not walk or place other material on top of stacked doors. Do not drag doors across one another.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Warranty: Provide written two (2) year warranty signed by door manufacturer, installer and Contractor agreeing to replace defective doors. Door defects include but are not limited to the following.
   1. De-lamination in any degree.
   2. Warp or twist of 1/4" or more in any 3'-0" x 7'-0" section of a door.
   3. Telegraphing of any part of core assembly through face veneer to cause surface variation of 1/100" or more in a 3" span.
   4. Other defects which affect performance of door.

C. Warranty shall cover the cost of refinishing, installation of hardware and re-hanging defective doors. Warranty shall be in effect for the following time periods.
   1. Provide manufacturer's warranty for life of install on all solid core and hollow core wood doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Medium-Density Overlay (MDO) Faced Doors for Opaque Finish:
   1. Algoma Hardwoods, Inc., Novodor Particle Core Doors.
   2. Eggers Industries, Master Flush-Particle.
   3. Lynden Door Co., CD200 Particle Board Core.
   4. Weyerhaeuser Company, Marshfield Series Timblend Particle Board Core DPC-1.
   5. Equivalent with same performance and warranty. Sub-contractor takes responsibility for product..
   6. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Finish - Factory primed and painted as indicated on the Drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Flush min 5-ply with M.D.O. faces with solid particle core bonded to stiles and rails using Type 1 waterproof glue; conforming to AWI Type PC-7.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Stiles: Two-ply laminated stiles. Outer ply 1/4" hardwood to match veneer face; inner ply 1/4 " mill option hardwood or softwood.
   2. Rails: 1-1/8" thick mill option hardwood or softwood. Thicker as required for hardware concealed fastener.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 081113.

B. Metal Louvers:
1. Manufacturer's standard matching wood inverted 'V' blade; sightproof.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
1. Algoma Hardwoods, Inc., Wood Beaded Lite W-4 Wood Bead.
2. Eggers Industries, Wood Beaded Lite with No. 105 Wood Bead.
3. Lynden Door Co.
4. VT Industries, Inc., VT-1
5. Weyerhaeuser Company, Marshfield Series, W-3 Wood Lite.
6. Or equivalent with same performance and warranty. Sub-contractor takes responsibility for product.

2.08 FABRICATION

A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.

B. Provide non-rated and 20 minute rated flush doors with 1-3/8" thick minimum, 2-ply edge bands, with outer ply 1/2" thick minimum edge strips of wood species compatible with to match face veneer.

C. Pre-fit and pre-machine doors for finish hardware, except for hardware items considered to be surface mounted, as specified in Section 087100. Comply with AWI Section 01330 for factory pre-fitting and pre-machining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

D. Examine door frames and verify that frames are correct type and have been installed for proper hanging of corresponding doors.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Pilot drill screw and bolt holes for surface applied hardware items.

E. Prepare doors to receive surface mounted finish hardware in accordance with AWI requirements.

F. Coordinate installation of doors with installation of frames and hardware.

G. Coordinate installation of glazing.

H. Condition doors to average prevailing humidity in installation area prior to hanging.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

C. Maximum Diagonal Distortion: 1/16" measured with straight edge, corner to corner.

3.04 ADJUSTING AND PROTECTION

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

C. Re-hang or replace doors which do not swing or operate freely.Refinish or replace doors damaged during installation.

D. Protect doors as recommended by door manufacturer to ensure that doors will not be damaged after installation.

END OF SECTION 081416

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SECTION 083100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling-mounted access units.

1.02 SUMMARY

A. This Section specifies the installation of all access doors, frames and related items including installation, hardware, and paint.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all access doors and related work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to procurement of access doors, and associated cuffing, fitting, cleaning and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   1. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

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

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.04 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

C. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 Wall- and Ceiling-MOUNTED ACCESS UNITS

A. Manufacturers:
1. Karp Associates, Inc: www.karpinc.com/#sle. (Basis of Design)
2. Comparable products equal to or exceeding specification requirements as manufactured by Milcor, Grand Rapids, MI, 800 624 8642 are acceptable..

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Design:
a. Frames shall be 16-gauge steel; panels shall be 20-gauge steel, sandwich type.
b. Panel shall be equipped with an automatic closing mechanism on doors over 144 sq. in. in size.
c. Lock assembly shall be cylinder type, self-latching with key operated cylinder lock and shall have a mechanism to release the latch bolt from the inside.
d. Hinges shall be continuous, steel with stainless steel pin.
e. Prime coat shall be factory-applied baked enamel over a protective phosphate coating on the steel.
f. Where designated in masonry walls, attach masonry anchors to frame assemblies in the factory.
2. Material: Steel.
3. Model:
a. Access doors in plaster surfaces shall be (30" x 20" Model DSC-214 PL).
b. Access doors in masonry or tile surfaces shall be recessed KRVB with optional anchor strap.
c. Access doors in wallboard surfaces shall be Model KDW unless noted otherwise. Reference Drawings for all locations and sizes.
d. Access doors in weather-protected masonry exterior walls shall be Type DSC-214 M.
e. Access doors fully exposed to weather (unprotected) exterior walls shall be Type "MX" or B-XT series as manufactured by Babcock-Davis, Brooklyn Park, MN, 888 412 3726.
f. Access doors in suspended fire-rated wallboard surfaces shall be Type KRP-I5OFR.

g. Access doors in canopy ceilings of wallboard or “Densglas” shall be 22” x 36” DSC-214M unless noted otherwise.
h. Fire rated access doors shall be Karp fire rated access doors.
1) Frame and panel assembly shall be manufactured under factory inspection service of UL and shall bear a label reading “Frame and Fire Door Assembly, Rating 1-1/2 hours (B), temperature rise 30 minutes, 250 deg F maximum.

4. Style:
a. Styles KRVB, DSC-214M and DSC-214PL.
1) Frame shall be 16-gauge; panel 14-gauge steel.
b. Style DSC— 214M by Karp or Type M by Milcor (Drywall) 16 gauge frame and 14 gauge door.
1) Continuous piano hinge.
2) Prime coat finish.
c. Style DSC-214PL by Karp or Type K by Milcor, casing bead of 22-gauge steel casing bead with metal lath shall surround the frame (plaster).
d. Style KRVB by Karp or Model 3601 by Milcor, flange shall be 16-gauge steel, 1” wide. (valve box).
1) Prime coat shall be factory applied, baked-on enamel, chemically bonded to the steel.
2) Hinges shall be concealed, continuous piano hinge.
3) Locks shall be flush, key operated cylinder locks.
e. Style KRP-15OFR by Karp or Type UFR by Milcor(fire rated).
1) Frames shall be 16 gauge steel; panel 20 gauge.
2) Prime coat shall be factory applied rust-inhibitive white paint.
3) Hinge shall be concealed, continuous piano hinge.
4) Locks shall be flush, key operated cylinder lock. Provide grommet for access to cam lock control.
5) Panel shall be equipped with an automatic self-closing mechanism with interior latch release.
f. Model 500-SL by L&L Louvers, Inc., email: info@louver1.com , Phone: 951-735-9300, (No substitutions)
1) Frames shall be 16 gauge steel; 14 gauge steel door
2) Finish coat shall be factory applied rust-inhibitive “light gray-semi gloss.”
3) Hinge shall be concealed, continuous piano hinge.
4) Locks shall be flush, screw drive operated.
5) Size: 24”x30”
6) Location: Rear of Entry Tower (Where indicated on the Drawings)

5. Frames: 16-gauge, 0.0598-inch minimum thickness.
6. Refer to drawings and mechanical/electrical sections of the specifications for locations and sizes.
7. Steel Finish: Primed.
8. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
9. Door/Panel Size: As indicated on the drawings.
10. Hardware:

a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

B. Install units in accordance with manufacturer's instructions.

C. Install frames plumb and level in openings, and secure units rigidly in place.

D. Position units to provide convenient access to concealed equipment when necessary.

E. Install access doors with trim less frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material.

F. Adjust doors and hardware after installation for proper operation.

G. At fully exposed to weather installation provide drip edge above top of frame and extend 4” either side of frame (minimum). Seal all exposed edges of frame and make weather tight (full perimeter).

H. Louvers in door panels at fully exposed to weather installation are to be weather tight.

END OF SECTION 083100

SECTION 083613
SECTIONAL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead sectional doors, manually operated.

B. Operating hardware and supports.

1.02 SUMMARY

A. This Section specifies the construction of all overhead sectional door assemblies and related items including installation of doors, tracks, mounting hardware, operators, hinges, rollers, locks, testing, and finishing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all overhead door assemblies and related work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of overhead doors, and associated welding, insulating, reinforcing, cutting, fitting, cleaning and finishing.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

C. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

D. DASMA 102 - American National Standard Specifications for Sectional Doors; 2018.

E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Show component construction, anchorage method, and hardware.

D. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material and mill test reports, substantiating compliance with requirements.

E. Welding Certificates.

F. Field quality control test and inspection reports,

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.
   1. Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

C. Where required by Code, Fire-Test-Response Characteristics: Provide assemblies complying with NFPA 80 that are identical to door and frame assemblies tested for fire-test-response characteristics per UL 10b and NFPA 252, and that are listed and labeled for fire ratings indicated by UL, FMG, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for warranty requirements.

B. Extended Correction Period: Correct defective work within a 2-year period commencing on Date of Substantial Completion.

C. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

D. Warranty Period: One (1) year commencing on Date of Certificate of Occupancy.

E. Additional requirements for product warranties are included in Section 016000.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

1.08 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead door assemblies capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components.
   1. Wind Load: As identified on the drawings.
   2. Impact Test for Flying Debris: Comply with ASTM E1996, tested according to ASTM E1886.

B. Operation-Cycle Requirements:
   1. Provide overhead door components capable of operating for not less than 10,000 cycles.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sectional Doors:
   1. C.H.I. Overhead Doors; Model 3281: www.chiohd.com.
   2. Overhead Door Corporation; Model 422: www.overheaddoor.com/#sle.
   3. Overhead Door Corporation; Model 429: www.overheaddoor.com/#sle.
      a. FOR USE IN FLORIDA PROJECTS ONLY
   4. Wayne-Dalton, a Division of Overhead Door Corporation; Model 5200: www.wayne-dalton.com/#sle.
      a. FOR USE IN FLORIDA PROJECTS ONLY

2.02 STEEL DOORS

A. Steel Doors: Flush steel, insulated; vertical lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Door Nominal Thickness: 2 inches thick.

B. Window and Frame: Manufacturers standard, finish to match.
   1. Minimum 24 inch x 6 inch window as indicated on the Door Schedule.
   2. Minimum 12 inch x 10 inch impact glazing for Florida Projects Only.

C. Mounting:
   1. Between-Jamb Bracket Mounting: sections mounted between door jambs, seal against exterior perimeter seal installed along vertical and top horizontal edges of jambs.
   2. Lap Jamb Angle Mounting: section overlap door jambs by 1 inch (25 mm) on each side of door opening.

2.03 COMPONENTS

A. Track:
   1. Material: Hot-dipped galvanized steel (ASTM A653/A653M), fully adjustable for adequate sealing of door to jamb or weather seal.
   2. Configuration Type:
      a. Configuration Type: Vertical Lift.
   3. Track Size:
      a. Size: 3 inches.
   4. Mounting:
      a. Floor-to-Header Angle-Mount consisting of fully adjustable, no-gap continuous angle extending from the floor up to the door header for use with steel, wood, or masonry jambs. Continuous angle size not less than 3-1/2 inches by 5 inches by 1/8 inches (89 by 127 by 3.2 mm) on 3-inch track.
      b. Floor-to-Shaft Angle-Mount consisting of fully adjustable, no-gap continuous angle extending from the floor, past header, completely up to door shaft for use with steel, wood, or masonry jambs. Continuous angle size not less than 3-1/2 inches by 5 inches by 1/8 inches (89 by 127by 3.2 mm) on 3-inch track.
   5. Finish: Galvanized.

B. Counterbalance:
   1. Counterbalance System: Provided with aircraft-type, galvanized steel lifting cables with minimum safety factor of 5. Torsion Springs consisting of heavy-duty oil-tempered wire torsion springs on a continuous ball-bearing cross-header shaft.
      a. Spring Cycle Requirements: Standard 10,000 cycles minimum.
   2. Spring Cycle Requirements: Extended cycle: 50,000 cycles.

C. End Stile Hinges and Brackets: Fabricated from galvanized steel.

D. Track Rollers: 3 inches (76.2 mm) diameter consistent with track size, with hardened steel ball bearings.

E. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

F. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

G. Head Weatherstripping: EPDM rubber seal, one piece full length.

H. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

I. Locks: Door furnished with two spring-loaded interior locks with dead bolt provided with hole to receive padlock provided by Owner.

2.04 MATERIALS

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.

B. Insulation: Foamed-in-place polyurethane, bonded to facing.
   1. R-value of 7.35 minimum.

C. Metal Primer Paint: Zinc molybdate type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verification of Conditions: Installer shall examine all dimensions and conditions under which the equipment are to be installed and notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

B. Apply primer to wood frame.

3.03 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions and the approved shop drawings.

B. Install doors in prepared openings. Set in their correct locations, level, plumb, square, at the proper elevation, in alignment with all work. Installation shall be performed under the supervision of an accredited or franchised representative of the manufacturer.

C. Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.

D. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section. Coordinate schedules for installation and orderly progress of the total construction sequence.

E. Deviation of site conditions contrary to approved shop drawings shall be called to the attention of the Architect.

F. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

G. Brackets shall be attached to continuous wall angle with 5/16" bolts.

H. Anchor assembly to wall construction and building framing without distortion or stress.

I. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

J. Fit and align door assembly including hardware.

K. After installation is completed, Manufacturer's representative shall examine the installation and require that all connections and adjustments necessary to assure proper operation of all equipment be made. Before acceptance, a demonstration shall be conducted in the presence of an Owner/Tenant's representative to guarantee that all equipment is operating properly in every respect. In addition, a detailed user/operator training session shall be conducted at time and place agreed upon by Owner/Tenant's representative and Manufacturer's representative.

3.04 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.

B. Maximum Variation from Level: 1/16 inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain doors.

B. Upon completion of the installation, put each operating component through at least 10 operating cycles. Adjust to achieve optimum operation.

3.06 CLEANING

A. Clean doors and frames and glazing.

B. Remove temporary labels and visible markings.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Upon completion of the installation, visually check exposed surfaces of the work of this Section and touch up scratches and abrasives to be completely invisible to the unaided eye from a distance of 5'-0".

C. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION 083613

SECTION 083800
TRAFFIC DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rigid and semi-rigid traffic doors.

1.02 SUMMARY

A. This Section specifies the construction of all impact doors and related items including installation, hardware, and paint.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all impact doors and related work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to fabrication and installation of impact doors, and associated cutting, fitting, aligning, fastening, cleaning and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Steel jambs and header.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's technical information for each type of door specified, including details about materials, components, profiles, gaskets, and finishes; include:
   1. Preparation and installation instructions and methods.
   2. Storage and handling requirements and recommendations.
   3. Operation and maintenance data.

C. Shop Drawings: Indicate installation details of doors and frames, including elevations and attachment.
   1. Submit complete detailed shop drawings prior to fabrication.
   2. Show, at large scale, the arrangement of pattern thickness, size or parts, size and location of cutouts in doors, full size molding profiles, face veneers, core construction and door manufacturer's name.
   3. Clearly show layout, designation, number, type, location and materials required.

4. Schedule: Door and frame schedule, including types, general locations, sizes, construction details, and other data pertinent to installation.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Executed warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of type specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing type of work specified in this section with not less than three years of experience and approved by manufacturer.
1. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. Guarantee:
1. Furnish manufacturer's standard "Life of the Installation" guarantee for all interior doors.
2. Repair or replacement shall include reasonable cost for re-hanging and refinishing.
3. Obtain detailed instructions on the limitations imposed on this guarantee by the door manufacturer's recommendations with respect to storage, installation, and maintenance, and shall notify all subcontractors of these requirements before any doors are delivered.
4. Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official.
5. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents, commencing on date of Certificate of Occupancy.
6. Additional requirements for product warranties are included in Section 016000.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver product in manufacturer's original unopened packages with label legible and intact.

B. Store doors at project site on edge or in upright position, under cover and elevated above grade, following manufacturer's instructions.
1. Do not deliver impact doors to the job site until a suitable storage room is provided to protect the doors from elements.
2. Examine doors for damage upon delivery. Verify proper shipping techniques were used.

3. Store doors according to manufacturer's instructions prior to hanging.
4. Do not install doors until plaster and wallboard operations are completed and buildings are protected from excessive temperature changes.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for molded polyethylene doors against damage due to vehicle traffic; state limitations in executed warranty. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 RIGID AND SEMI-RIGID TRAFFIC DOORS

A. Construction: Manufacturer's standard.
1. Door Assemblies: Double-acting, self-closing pairs of doors for installation in frame provided by others; factory fabricated and finished, complete with hinges and specified accessories.
a. Door Swing: Minimum of 90 degrees each direction.
b. Hinges: V-cam gravity hinges at top and pivots at bottom; mounted on bottom of header and on top of floor; maximum rise 1-1/2 inches; vertical and horizontal adjustment in the field; manufacturer's standard lower hinge guards.
c. Hinge Guards: Manufacturer's standard material and configuration to protect lower hingefinish floors from damage.
d. Exposed Metal Parts: Either stainless steel, extruded aluminum, or powder coated.
e. Dimensional Tolerances: Plus or minus 1/4 inch in width and height of each panel.

B. Heavy Duty Proprietary Flexcor Panel.
1. Single Doors to be Model Q250-500 as manufactured by Mueller Door co. Single Doors to be construction of 3/4" total door thickness, Mueller proprietary FlexCore.
2. Pair Doors to be Model Q250-750 as manufactured by Mueller Door Co. Pair Doors to be constructed of 3/4" total door thickness, Mueller proprietary FlexCore.
3. Construction: Manufacturer's standard construction reinforced for durability and rigidity, with edges, cut-outs, and hardware preparations factory fabricated; provide view window cut-outs with joints sealed independently of glazing or trim.
4. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary.
5. Gaskets: Replaceable rubber gaskets in molded integral key extrusion on edge of door.
6. Window size: As noted on the Drawings; ADA Compliant, Patented Gasket Free.
7. Window Glazing: Clear Polycarbonate
8. Color: Black, verify with Architect prior to ordering.
9. Hinges: Double Action Q Series. Black Zinc Coated.
10. Jamb Guards: Integrated in the door beam.
11. Flat impact plates 36" high.

12. Products:
    a. Mueller Door Co.; 27750 W Concrete Dr., Ingleside, IL 60041, Tel.: (800) 981-2040 or (815) 385-8550, Fax: (815) 385-8653. Email: Suzanne@MuellerDoor.com.
        1) Contact: Suzanne Miller – Cell: (815) 385-8653
    b. Substitutions: See Section 016000 - Product Requirements. Substitutions shall be requested only if there is an availability or lead time issue that will affect the construction schedule. If such a delay is found, General Contractor is to contact Sprouts immediately.

2.02 ACCESSORIES

A. Provide tamper proof fasteners and other hardware as recommended by manufacturer for complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that jambs and frames are square and plumb.

B. Verify that opening is ready to receive work and opening dimensions and clearances are as indicated on drawings.

C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

D. Commencement of work by installer indicates acceptance of opening conditions.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Place frames prior to construction of enclosed walls and ceilings

B. Set frames according to manufacturer’s written instructions, accurately in position, plumb, aligned, and braced securely until permanent anchors are set.

C. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

D. Doors shall be accurately fit with proper clearances and left in perfect working order.

E. Install doors with clearances, anchors, hardware, and accessories according to the manufacturer's instructions and as specified.

F. Install doors plumb, level, and properly aligned.

G. All re-fitting necessary due to swelling, shrinking, faulty assembly or installation shall be done by the contractor, without cost to the Owner, for a period of two (2) years after completion and acceptance of the building.

H. When dressing or cutting has been done, these surfaces shall be repainted or varnished.

I. Provide standard pre-fit clearances of 1/8" at top, 1/8” each side, and minimum 3/8" at bottom; increase bottom clearances over carpet and saddles. Verify gap requirements with local municipalities (health department) prior to installing door or frame.

3.04 ADJUSTING

A. Clean and lubricate operating parts.

B. Adjust doors to open and close smoothly and freely without binding and for proper fit of seals.

C. Leave work in complete and proper operating condition.

D. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise damaged.

3.05 CLEANING

A. Clean surfaces using methods as recommended by manufacturer.

B. Immediately after erection, sand smooth any rough or damaged areas and apply touch-up so that there is no visual evidence of touch up.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 083800

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SECTION 084229
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior and Exterior sliding type packaged power-operated door assemblies.

B. Controllers, actuators and safety devices.

1.02 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants

B. Section 087100 - Door Hardware

C. Section 088000 - Glazing

1.03 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to activate the operation of the door.
   1. Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

C. Safety Device: A device that detects the presence of an object or person within a zone where contact could occur and provides a signal to stop the movement of the door.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. BHMA A156.10 - Power Operated Pedestrian Doors; 2024.

D. ISO 14644-1 - Cleanrooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness by Particle Concentration; 2015.

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

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings:
1. Submit manufacturer’s shop drawings, including elevations, sections and details, indicating dimensions, materials, and fabrication of doors, frames, sidelites, operator, motion /presence sensor control device, anchors, hardware, finish, options and accessories.
2. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
3. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

C. Product Data: Include system components, sizes, features, and finishes.
1. Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, fabrication, operational descriptions and finishes.

D. Manufacturers Field Reports: Submit manufacturer’s field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA A156.10 after completion of installation.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door opening installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the entrance and their nearest service representatives. The final copies delivered after completion of the installation test to include spare parts list.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

G. Maintenance Contract.

H. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
1. As-Built Record Documents showing actual installation conditions and wiring.
2. Parts lists and maintenance instructions including data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

I. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

J. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

K. Executed warranty.
1. 3-year limited warranty against defective material or workmanship.
2. 5-year limited warranty Motor/Encoder warranty.

L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Wrenches and other tools required for maintenance of equipment.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 10 years of documented experience and successful in-service performance, and a member of AAADM.
1. Capable of providing field service representation during installation. Automatic Sliding Door Drive and Control System Products shall be manufactured in an ISO 9001 registered manufacturing facility.
2. All equipment shall comply with ANSI A156.10/A117.1, NFPA 101, UL 325, ISO 14644-1 Class 2 Cleanroom Standards, and AAADM.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented successful experience and approved by manufacturer.
1. Certified by AAADM.

C. Certified Inspector Qualifications: Certified by AAADM.

D. Source Limitations for Automatic Entrances: Obtain each type of door, frame, operator and sensor components specified in this Section from a single source, same manufacturer unless otherwise indicated.

E. Power-Operated Pedestrian Door Standard: ANSI/BHMA A156.10 (current version).

F. Emergency Exit door requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

1.07 DELIVERY, STORAGE AND HANDLING

A. Package hardware items individually with necessary fasteners and installation templates when necessary; label and identify each package with door opening code to match door schedule.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

D. Store materials in a dry, warm, ventilated weathertight location.

1.08 PERFORMANCE REQUIREMENTS

A. Automatic sliding door system shall be certified by the manufacturer to meet performance design criteria according to the following test standards:
   1. ANSI/BHMA A156.10 American National Standard for Power Operated Pedestrian Doors.

B. Accessibility Requirements: Comply with requirements of Local building code, and Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities.

C. Automatic door equipment accommodates medium to heavy pedestrian traffic.

D. Entrapment Force Requirements:
   1. Power Operated Sliding Doors: Not more than 30 lbf (133 N) required to prevent stopped door from closing.
   2. Sliding doors provided with a breakaway device shall require no more than 50 lbf (222N) applied 1 inch (25 mm) from the leading edge of the lock stile for the breakout panel to open.

1.09 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication and indicate on shop drawings.

1.11 COORDINATION

A. Coordinate work with other directly affected components involving manufacture or fabrication of reinforcement for door hardware and recessed items.

B. Coordinate sizes and locations of recesses in concrete floors for recessed tracks and thresholds if applicable. Concrete work is specified in Division 03.

C. Coordinate work with other directly affected components involving electrical wiring and components.
   1. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access control system as applicable.

1.12 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Automatic Entrance Doors shall be free of defects in material and workmanship for a period of Three (3) years from the date of substantial completion.

D. During the warranty period a factory-trained technician shall perform service and affect repairs. An inspection shall be performed after each adjustment or repair.

E. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal business hours.

F. Manufacturer shall have in place a dispatch procedure that shall be available 24 hours a Day, 7 Days a week for emergency call back service.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sliding Automatic Entrance Door Assemblies:
1. ASSA ABLOY Entrance Solutions; Besam SL500: 1900 Airport Road, Monroe, NC 28110. Toll Free (877) SPEC-123. Fax (704) 290- 5555, website: www.assaabloyentrance.us, Contact: Ross.Merkling@assaabloy.com

B. Sliding automatic entrance system including the following:
1. Sliding panels, break-away sidelites and aluminum frame.
2. Overhead concealed, electro-mechanical operator.
3. Operator housing, guide system and carrier assemblies.
4. Controls and accessories as required for a complete installation.

C. ASSA ABLOY SL500 Automatic Sliding Entrance with Stile and Rail Panels (Basis of Design):
1. Bi-parting, break-away sidelites, door system.
2. Configuration: Bi-parting, four equal panel unit with two operable leaves and two break-away sidelites.
3. Traffic Pattern: Two-way.
4. Emergency Break-away Capability: Sliding leaves and sidelites.
5. Mounting: Overhead header installed between jambs.

2.02 POWER OPERATED DOORS

A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
   1. Door Carriers: Manufacturer's standard carrier assembly that allows vertical adjustment.
      a. Carriage Assembly: Carriage bar with two wheel assemblies. Each assembly shall have tandem roller wheels.
      b. Roller Wheels: Two heavy duty Delrin roller wheels per wheel assembly, for a total of four (4) roller wheels, 1-7/16 inch (36.51 mm) diameter, per active door leaf for operation over a replaceable aluminum track. Single journal with sealed oil impregnated bearings.
      c. Two (2) heavy duty self-aligning anti-risers per leaf.
   2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
      a. Finish exposed equipment components to match door and frame finish.

B. Stile and Rail Sliding Panels and Sidelites:
   1. Material: Extruded Aluminum, Alloy 6063-T5.
   2. Door panels shall have a minimum .125 inch (3.2 mm) structural wall thickness including adjoining horizontal members and perimeter frames where applicable.
   3. Door Construction shall be by means of an integrated corner block with 3/8 inch all-thread through bolt from each stile.
   4. Glass stops shall be .062 inch (15.8 mm) wall thickness and shall provide security function as a standard by means of a fixed non-removable exterior section with glazing to be performed from the interior only.
   5. Full breakout sliding entrances shall include two interlocks per moving panel securing the leading stile of the sidelite and the butt stile of the sliding door panel together.
   6. Vertical Stiles shall be narrow stile 2-1/8 inch (54 mm).
   7. Bottom Rails shall be 10 inch (254 mm).
   8. Intermediate Muntin shall be 1-3/4 inch (45 mm).
   9. Weather-Stripping: Slide-in type, replaceable pile mohair seals retained by the aluminum extrusions. The following types of weather-stripping are required: complementing weather-stripping on the joining vertical stiles of the sidelite and sliding door panels, complementing weather-stripping on the lead edge of the lock stiles of bi-parting doors, single pile weather-stripping between the carrier and the header, single pile weather-stripping on the lead edge stile of single slide door panels, dual pile weather-stripping on the pivot stile of breakout sidelite panels, and dual pile weather-stripping on the butt stile of break-away sidelite panels. Bottom rails shall be provided with an adjustable nylon sweep.
      a. Exterior Entrance EcoDoor Seals: High pile mohair weather stripping on the lock stile of the sliding doors, integrated mohair weather stripping with vinyl fin on the joining vertical stiles of the sidelite and sliding door panels, and expandable foam inserts in leading stile of sidelite panels at pockets for interlocks. Bottom rails shall be provided with a concealed adjustable nylon sweep.
   10. Glass: Glazing shall comply with ANSI Z97.1, thickness as indicated.
      a. Interior Entrance Glazing: 1/4" (6 mm) clear tempered glass.

b. Exterior Door Glazing: 1” clear Insulating, tempered glass, Low E.

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. Comply with ADA Standards for egress requirements.

B. Framing Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
   1. Nominal Sizes:
      a. Bi-Parting Sliding Doors: 1-3/4 inch wide by 4-1/2 inch deep.
   2. Concealed Fastening: Provide concealed fastening pocket in framing, with continuous flush insert cover extending full length of each framing member.

C. Header: Manufacturer’s standard extruded aluminum header with a replaceable aluminum track extending full width of entrance unit. Header to conceal door operators, carrier assemblies, and roller track; complete with hinged access panel for service of door operator, and controls.
   1. Header Span: Maximum 16’-0” (4.9 m) without intermediate supports when entrance glazed with 1/4-inch glass.
      a. Capacity: Capable of supporting active breakout leafs up to maximum of 300 lb (136 kg) per leaf when header is supported per manufacturer’s recommendations.
   2. Header Size: 4-1/2 inches (114.3 mm) wide by 7 inches (177.8 mm) high.
      a. Header height including the sensor plate cap which spans the clear door opening width is 8 inches (203.2 mm) high.
   3. Header Access: Continuous hinge at top of header allows cover to swing and allow complete access to operator and internal electronic and mechanical assemblies.
   4. Design: Closed header when doors in closed position.

2.04 HARDWARE

A. Hardware: Provide manufacturer’s standard hardware as required for operation indicated.
   1. Breakaway arms and bottom pivot assemblies shall be supplied by the manufacturer and shall be adjustable to comply with applicable codes.
   2. Magnetic catch(s) to retain breakout door and sidelite panels in the closed position.
   3. Locking hardware shall be provided as indicated.
      a. Two-point locking system with throw rod into carrier arm and mortise hookbolt. (Bi-parting sliding entrance).
         1) Interior Side: Thumbturn. Lock indicators shall be provided if required by code.
         2) Exterior Side: Keyed cylinder.
   4. Keyed cylinders shall be provided as indicated.
      a. Keyed cylinder with replaceable core.

B. Guide Track/Threshold: Manufacturer’s threshold as indicated.
   1. Break-away Sidelite Entrance Threshold: 1/2 inch (12.7 mm) high continuous aluminum threshold with integral track shall span the width of the sliding door header and fit between the vertical framing members. Threshold design shall allow for optional extruded ramps to securely interlock to flat section to meet ADA requirements.

2.05 CONTROLLERS, ACTUATORS, AND SAFETIES

A. Door Operator and Controller: Provide microprocessor operated controller for each door.
   1. Electro-mechanical controlled unit utilizing a high-efficiency, energy efficient, DC motor requiring a maximum of 3 amp current draw, allowing 5 operators on one 20 amp circuit. The supplied system shall have the capability to operate at full performance well beyond a brown out and high line voltage conditions (85V – 265V) sensing changes and adjusting automatically. The operator shall allow an adjustable hold open time delay of 0 to 60 seconds and have internal software to incorporate a self-diagnostic system.
   2. Operating Temperature Range: -31° F to 130° F (-35° C to 54.44° C).
   3. Microprocessor Control Box:
      a. Modular control unit to allow for changing technology. Factory-adjusted configuration with opening and closing speeds set to comply with ANSI/BHMA A156.10 requirements and electronic dampening to reduce wear on drive train. Should the drive train operations deviate from design criteria ranges, Watchdog Control Circuit Monitoring will assume command of the system and shut down the automatic function allowing a secondary supervisory circuit to perform as a backup. Control unit shall allow the following functions:
         1) Diagnostics with the ability to produce application data.
         2) Mode Selector Control Mounting: Control shall be mounted as indicated:
            a) Jamb mounted.
         3) Mode selector control to allow the following functions:
         4) “Off”
         5) “Exit Only” one way traffic with automatic operation from the interior.
         6) “Two Way Traffic” allowing automatic operation from exterior and interior.
         7) “Partial Opening” energy saving door position allows door to automatically adjust opening width based on amount of usage, that is, full open during high use and partial open during low use. The control for this setting is programmable allowing adjustment to both the usage setting and the opening width.
         8) “Hold Open” doors activated and held in the full open position.

B. Comply with BHMA A156.10 for actuator and safety types and zones.

C. General: Provide the types of activation and safety devices specified in accordance with ANSI/BHMA standards, for the condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

D. Combination Activation Motion Sensor/Safety Presence Sensor:
   1. Shall be a sliding door sensor utilizing K-band microwave technology to detect motion and focused active infrared technology to detect presence, combined in a single housing surface mounted on each side of the header.
      a. Presence sensor shall remain active at all times.
      b. The sensor shall communicate with the automatic door operator through a self-monitoring connection that allows the door to go into a fail-safe mode preventing the door from closing in the event of a sensor failure.
   2. Motion/presence detecting sensors to be field installed and adjusted.

2.06 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. High-Efficiency DC Motor: Maximum of 3 amp current draw, allowing 5 operators to run on one 20 Amp circuit.
   2. Power: Self-detecting line voltage capable control. 120 VAC through 240 VAC, 50/60 Hz, 3 amp minimum incoming power with solid earth ground connection for each door system.

B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

C. Disconnect Switch: Factory mount disconnect switch in control panel.

D. Key Impulse Input: Input for card readers or remote activation with independent adjustable hold open delay.

E. Wiring: Separate internal channel raceway free from moving parts.

F. Brown out / high voltage capability: System has capability to operate at full performance well beyond brown out and high voltage line conditions (85 V – 265 V) sensing changes and adjusting automatically.

G. Convenience Battery: Shall be concealed in header and capable of full operation with blackout conditions, including sensor capabilities for minimum of 100 cycles.

2.07 FINISH

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Anodized Finish:
   1. Color: As indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.

B. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
   1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that electric power is available at rough-in, at the correct location, and is of the correct characteristics.

D. Do not begin installation until substrates have been properly prepared.

E. Verify that other trades are complete with their required work before installing the automatic door operating system.

F. Mounting surfaces shall be plumb, straight, and secure; substrates shall be of proper dimension and material; material which door is anchored to shall be capable of supporting the automatic door system and associated loads.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Install equipment in accordance with manufacturer's written instructions, except where more stringent requirements are specified.

C. Install entrances securely anchored in place, plumb, level, and true to location, in alignment with established lines and grades, without warp, bow, or racking of members.
1. Install surface mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets and guides level and true to location with anchorage for permanent support.

D. Where frames are assembled in field, fit frame joints hairline tight without burrs or distortion; rigidly secure nonmoving joints and seal watertight.

E. Provide all fasteners required for installation of the automatic sliding door system.

F. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.

G. Provide for dimensional distortion of components during operation.

H. Coordinate installation of components with related and adjacent work; level and plumb.

I. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections and on Electrical Drawings.

J. Glazing: Glaze sliding automatic entrance door panels in accordance with the Glass Association of North America (GANA) Glazing Manual, published recommendations of glass product manufacturer, and published instructions of automatic entrance system manufacturer.

K. Sealants: Comply with requirements specified in division 7 Section “Joint Sealants” to provide a weather tight installation.

1. Set thresholds, bottom guide and track systems and framing members in full bed of sealant.
2. Seal perimeter of framing members with sealant.

L. Signage: Apply signage on both sides of each door and sidelite as required by ANSI/BHMA A156.10 and manufacturers installation instructions.

3.04 ADJUSTING

A. Adjust entrances for correct function and smooth operation, without binding or scraping and without excessive noise; lubricate operating hardware and other moving parts.

B. Adjust doors in compliance with ANSI/BHMA A156.10.

C. Verify installation and alignment of all entrance weather-stripping as required for compliance with specified air infiltration requirements.

D. After repeated operation of the completed installation, inspect door operators and controls for optimum operating condition and safety.

3.05 FIELD QUALITY CONTROL

A. Before placing doors into operation, AAADM certified technician shall inspect and approve doors for compliance with ANSI/BHMA A156.10. Certified technician shall be approved by the manufacturer.

3.06 CLEANING

A. Remove temporary protection; clean exposed surfaces.

B. Clean all metal surfaces promptly after installation.

C. Remove temporary protection, clean exposed surfaces.

3.07 CLOSEOUT ACTIVITIES

A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

B. Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of the door.

3.08 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.09 MAINTENANCE

A. Provide a separate maintenance contract for specified maintenance service.

B. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

END OF SECTION 084229

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

1.02 SUMMARY

A. This Section specifies the construction of all aluminum frame assemblies, hardware and other related materials including installation, clips, shims, hinges, reinforcement, and finishing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all aluminum frame work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to associated welding, anchoring, aligning, inspecting, reinforcing, cutting, fitting, and cleaning.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

D. Coordination of Fabrication: Check the actual openings in the construction work by accurate field measurement before fabrication and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress as directed and avoid delays of the work.

1.03 RELATED REQUIREMENTS

A. Section 084229 - Automatic Entrances.

B. Section 088000 - Glazing: Glass and glazing accessories.

1.04 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2025.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

D. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

I. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2023.

J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

M. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

N. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

O. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

P. FLA (PAD) - Florida Building Code Online - Product Approval Directory; Current Edition.

Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Manufacturer's Data: Submit copies of manufacturer's written guarantee specifications, recommendations and standard details for aluminum frames and components of the work.
   1. Include all wall elevations at 1/2" scale, and full-size detailed sections of every typical composite member.
   2. Show anchors, joint system, expansion provisions, and other components not included in manufacturer's standard data. Include glazing details.
   3. Submit 2 copies of written guarantee signed by the manufacturer, installer and contractor, agreeing to replace aluminum window wall units which fail in materials or workmanship within 2 years of the date of acceptance.
      a. Failure of materials or workmanship shall include (but not be limited to) excessive leakage or air infiltration, excessive deflections, and deterioration of finish or metal in excess of normal weathering and defects in accessories, weather stripping, and other components of the work.

D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

E. Product Test Reports.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

G. Provide Florida Building Code (FBC) Product Approval or Miami Dade County Notice of Acceptance testing report for storefronts demonstrating compliance with appropriate wind zone and speed. Products used for this section shall not require shuttering to comply with hurricane conditions. Products to be hurricane rated as installed (lock and go).

1.07 QUALITY ASSURANCE

A. Standards: Except as otherwise indicated, the requirements for aluminum frames, and the terminology used in this Section, are those of NAAMM (Entrance Manual), AAMA and AA.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
   2. Specifications are based on products as manufactured by Arcadia, Inc., Vernon, CA, 323 771 9819. Equal products as manufactured by United States Aluminum, Los Angeles, CA 800 421 6144, and Kawneer, Norcross, GA, 770 449 5555 are acceptable subject to approved substitution request.

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

1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer's instructions for installation shall be delivered and stored with the materials.

F. Testing: As required by the latest industry codes and standards.

G. Tolerances shall conform to industry codes and standards, except as otherwise noted.

H. Testing Agency Qualifications: An independent agency qualified according to ASTM E699 for testing indicated.

I. Structural-Sealant Glazing: Comply with recommendations in ASTM C1401, "Guide for Structural Sealant Glazing."

J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

K. ASTM E331 - Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.

L. Americans with Disabilities Act of 1990, Accessibility Guidelines for Buildings and Facilities

M. ICC A117.1 – Accessible and Useable Building and Facilities.

N. ASTM E1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

O. ASTM E1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

P. Florida and HVHZ Building Code Requirements:
1. Products of exterior window components or assemblies shall have Florida Building Code (FBC) Product Approval, Miami-Dade County Product Control Notice of Acceptance (NOA), or the product approval of any other state or local Authorities Having Jurisdiction in the project location. Product approvals meeting the requirements of the current building code are necessary to obtain permits required for acceptance of work by Jurisdictional Authorities.
2. Labeling: Exterior windows shall be labeled in accordance with the requirements of the Building Code.
3. Provide exterior window and door components and assemblies approved for design pressures calculated in accordance with the state or local building code and bearing approval numbers for intended applications and functions of exterior assembly. Provide window systems tested as an assembly using components stated in product approval documents.

4. Verify acceptance of product approvals by Authorities Having Jurisdiction before fabrication or delivery. The various systems, in their fabrication and installation, shall comply with the approval acceptance criteria and supporting drawings and documentation.
5. Verify products or assemblies have product approval, that product approval numbers are valid and current, and that related construction assemblies and components are used to ensure approval by Authorities Having Jurisdiction. Where approval document numbers specified herein or associated products are not current or not otherwise applicable, notify the Architect by Request for Information (RFI) for clarification.
6. Approval criteria shall take precedence over specific product models and product requirements specified herein. Where components and characteristics associated with the approval documents differ with the requirements stated herein, the approved requirements shall govern and shall be provided.

Q. Windborne-Debris-Impact Resistance: Provide exterior doors and storefront framing that pass basic-protection testing requirements in ASTM E1996 when tested according to ASTM E1886.
1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located more than 30 feet above grade.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

C. Transport, handle, and deliver to the job frames in manufacturer prepared packaging in a vertical position, covered on 4” wood sills in a manner to prevent rust, moisture damage, and damage from ongoing construction activities.

D. Additional requirements for product delivery, storage and handling are in Section 016000.

1.09 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

C. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
1. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefronts:
   1. Arcadia, Inc; AG450/451 Series : www.arcadiainc.com/#sle.
   2. Kawneer North America; Trifab 451 Series: www.kawneer.com/#sle.
   3. United States Aluminum Series 450.

2.02 MANUFACTURERS (WIND-BORNE DEBRIS REGIONS)

A. Aluminum-Framed Storefronts:
   1. Arcadia, Inc; IP2551 Series (Impact rated, non-thermal): www.arcadiainc.com/#sle.
   2. Kawneer North America; IR 350 Series (WBDR rated, non-thermal): www.kawneer.com/#sle.
      a. Miami-Dade County NOA #11-0915.06 and 09-0218.07
      b. Florida Product Approval # FL 8787 / FL 15404
   3. United States Aluminum (Division of C.R. Laurence Co., Inc) Series Storm Front IG 600 (HVHZ / Large Missile Impact Rated) .
      a. Miami-Date County NOA# 17-1025.11
      b. Florida Product Approval # FL 15711.3 R3 (Approved for HVHZ) (Expires 12/31/2023)

2.03 PERFORMANCE REQUIREMENTS

A. System Performance: Provide manufacturer's stock system, adapted to application indicated, which has been tested in accordance with ASTM E330/E330M to withstand at least the following loading:
   1. Minimum uniform pressure of 20 psf inward and 20 psf outward, or as required by local Municipal Building Code (whichever is greater).
   2. Maximum deflection of framing members normal to wall plane shall be whichever has the least deflection of the following:
      a. Limited to 1/175 of clear span for spans up to 13’-6”.
      b. Limited to 1/240 of clear span plus 1/4" for spans greater than 13’-6”.
      c. Or an amount that restricts edge deflection of individual glazing lites to 3/4".

B. Manufacturer entrances and storefronts shall be designed in accordance with the following leakage requirements:
   1. ASTM E283/E283M not to leak air more than .06 cm per sq. ft. wall area
   2. ASTM E331 for water leakage.

C. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Seismic Loads: As indicated on Drawings.

2.04 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Wind-Borne-Debris Resistance Tested:
   1. Basis of Design: IP2551 Series (2” x 5”) HURRICANE REGIONS.

B. Center-Set Style, Thermally-Broken:
   1. Basis of Design: AR450 Series (2” x 4-1/2”) for 1/4" glass and AG451 Series (2” x 4-1/2”) for 1” insulating glass.

2.05 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class II natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, having Florida Building Code FLA (PAD) approval for Large and Small Missile impact and pressure cycling at design wind pressure.
   3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

2.06 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.

B. Glazing: See Section 088000.
   1. Storefront system: Install anodized frame members to receive 1/4" thick clear glass or 1" thick insulating glass – see drawings for type and tint.
      a. Tempered glass - Safety tempered glass at panels located either side as scheduled on drawings.
      b. **IR Rated [Impact Resistant]** glass - Safety tempered glass at panels located either side as scheduled on drawings.
      c. Materials: Frames - Extruded 6063-T6 Aluminum alloy not less than 0.125" thick.
      d. Aluminum Members: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish; ASTM B221 for extrusions, ASTM B209/B209M for sheet/plate.
      e. Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.
      f. Do not use exposed fasteners except where unavoidable for application of hardware. All exposed fastener to match finish of adjoining metal finish.
      g. Provide Phillips flat-head machine screws for exposed fasteners.
      h. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, type selected by manufacturer for compatibility.
      i. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A123/A123M.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

D. Concrete/Masonry Inserts: Cast iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 153.

E. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC-PS 12, compounded for 30-mil thickness per coat.

F. Slip Header Track: Provide at all Storefront heads, at Frame Walls - color to match storefront.

2.08 FINISHES

A. Clear Protective Coatings: AAMA 602.2, compounded specifically for protection of aluminum finish during construction.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.010 mils thick.

C. Color: As indicated on drawings.

2.09 FABRICATION

A. General Sizes and Profiles:
   1. Required sizes for frame units, including profile requirements, are as indicated on the drawings.
   2. Any variable dimensions are indicated together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

B. Prefabrication: To the greatest extent possible, complete fabrication, assembly, finishing hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

C. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

D. Sequence: Complete cutting, fitting, forming, drilling and grinding of metal work prior to cleaning, finishing, surface treatment, and application of finishes. Remove arises from cut edges and ease edges and corners to radius of approximately 1/64".

E. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

F. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

G. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

H. Fasteners: Concealed wherever possible.

PART 3 EXECUTION

3.01 EXAMINATION

A. The storefront contractor must examine the supporting structure for the conditions under which the work is to be erected, and notify the contractor in writing of conditions detrimental to proper and timely completion of the work.

B. Verify dimensions, tolerances, and method of attachment with other work.

C. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

D. Do not proceed with erection until unsatisfactory conditions have been corrected in a manner acceptable to the storefront contractor.

3.02 INSTALLATION

A. Do not install component parts that are observed to be defective in any way, including warped, bowed, dented, abraded and broken members and including glass with glass damage.

B. Remove and replace members that have been damaged during installation or thereafter before the time of final acceptance.

C. Do not cut, trim, weld or braze component parts during erection, in any manner which would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the storefront.

D. Return component parts that require alteration to the shop for re-fabrication, if possible, or for replacement by new parts.

E. Install wall system in accordance with manufacturer's instructions.

F. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

G. Provide alignment attachments and shims to permanently fasten system to building structure.

H. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   1. Use erection equipment that will not mar or stain finished surfaces and will not damage the component parts in any way.

I. Provide thermal isolation where components penetrate or disrupt building insulation.

J. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

K. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

L. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

M. Frame installation
   1. General:
      a. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
      b. Seal joints watertight, unless otherwise indicated.
   2. Metal Protection:

a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 - Joint Sealants and to produce weathertight installation.
5. Entrances: Install to produce smooth operation and tight fit at contact points.
   a. Exterior Entrances: Install to produce tight fit at weather stripping & weathertight closure.
   b. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

B. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
1. Perform a minimum of two tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. The storefront contractor shall advise the Contractor of proper and adequate means for protecting portions of the work that are exposed to likely sources of damage during the remainder of the construction period, including the probable areas of glass breakage or deterioration.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

D. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

E. Prepare a "Cleaning and Maintenance Manual" listing the types of cleaning compounds, cleaning methods, and types of sealants and glazing materials to be used for cleaning, repair and maintenance of the work.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors.

B. Electrically operated and controlled hardware.

C. Thresholds.

D. Weatherstripping and gasketing.

1.02 SUMMARY

A. This Section specifies the furnishing and installation of all hardware assemblies including fasteners, templates, locks, latch sets, keys, strikes, push plates, pull plates, kick plates, signs, closers, stops, weatherstripping, thresholds, paint, and testing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all hardware assemblies, as indicated on the Drawings or as specified herein. This work shall include but not be limited to procurement and installation of hardware and associated cuffing, fitting, fastening, cleaning and painting.

C. Installation shall be in compliance with Federal ADA Guidelines, Installation of all hardware (except that noted by storefront supplier) is to be by General Contractor.

D. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 281000 - Access Control: Electronic access control devices.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. BHMA A156.1 - Standard for Butts and Hinges; 2021.

C. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.

D. BHMA A156.3 - Exit Devices; 2025.

E. BHMA A156.4 - Door Closers and Pivots; 2024.

F. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

G. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.

H. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

I. BHMA A156.21 - Thresholds; 2025.

J. BHMA A156.22 - Standard for Gasketing; 2021.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

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

M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

N. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
   1. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
   1. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. Guarantee:
   1. Contractor shall guarantee all hardware for a period of two (2) years from date of acceptance of work. Defects in materials and/or workmanship occurring during the guarantee period shall be corrected at no expense to the Owner.
   2. Submit for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
   3. Additional requirements for product warranties are included in Section 016000.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.
   1. Mark each container with an item number corresponding to the item number on the finish hardware schedule.
   2. Containers holding keyed locks and cylinders shall show the following: heading number, door number, hand of door (when required) and keying symbol; all corresponding to that shown on the finish hardware schedule.

B. Additional requirements for product delivery, storage and handling are in Section 016000.

1.07 FIELD CONDITIONS:

A. General Requirements:
   1. Contractor shall be responsible for arranging all work and issuing all purchase orders to facilitate securing delivery of all hardware and appurtenances, so all work shall progress without delay or interruption.
   2. Upon delivery of the finish hardware to the job site, check in and sign for all material delivered, and thereafter be responsible for same.
   3. Provide a room with sufficient space and shelving in which to lock and arrange the finish hardware. This room shall be locked with a lock furnished for this project. Protect hardware from damage at all times, both prior to and after installation.
   4. Tab and turn all keys over to the Owner upon completion of the work.

B. Specific Requirements:
   1. The following hardware schedule is intended to cover all doors and establish a type and standard of quality. Where the size and shape of members to be equipped with hardware prevents or makes unsuitable the use of exact types specified, Contractor shall furnish suitable types having as nearly as practicable the same operation, function, style, and quality as that specified.
   2. Sizes shall in all instances be adequate for the service to which the individual items of hardware will be subjected in the course of normal usage.
   3. It shall be the specific duty and responsibility of the finish hardware supplier to examine the Specifications, Drawings, and details, and furnish the proper hardware for all openings, whether listed or not.
   4. If there are any omissions in the hardware groups in regard to regular doors, they shall be called to the attention of the Architect for instructions, prior to bid opening; otherwise, the list will be considered complete. No extras will be allowed.

C. Templates:
   1. The finish hardware supplier, upon receipt of reviewed finish hardware schedule, shall send an approved schedule along with a complete template list for all items requiring template information to the hollow metal manufacturer, aluminum door and frame supplier, or any other supplier requiring this information.
   2. When hardware must be installed at the factory, the hardware supplier shall send all such needed items to the respective supplier for their use in installation. The cost of this shipping requirement shall be borne by the hardware supplier.

D. Template Hardware:
1. All hardware supplied to metal doors or jambs shall be made to template and secured by machine screws.
2. Where cylindrical locks are used in hollow metal doors, the door manufacturer shall furnish lock reinforcing in the door at the time of manufacture.
3. 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.

E. Fasteners:
1. Furnish finish hardware with all necessary screws, bolts, or other fastenings of suitable size and type to anchor the hardware in position for heavy use and long life, and to harmonize with the hardware as to material and finish.
2. Furnish fastenings where necessary with expansion shields, hex bolts, toggle bolts, and other approved anchors according to the material to which it is applied, and as recommended by the manufacturer.
3. Furnish hardware fastened to concrete with machine screws and tap-ins.
4. Fasteners for closers on wood or mineral core doors shall be hex bolts.

1.08 WORK SPECIFIED ELSEWHERE

A. Hardware for the following items will be furnished under other Sections of these Specifications.
1. Casework.
2. Thresholds not listed in the hardware list.
3. Hardware for aluminum doors, except as listed in the hardware list.
4. Toilet compartments.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

1. See Section 281000 for additional access control system requirements.

E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.

F. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
a. Aluminum fasteners are not permitted.
b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Fire-Rated Applications: Comply with NFPA 80.
a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 HINGES

A. Manufacturers:
1. Hager Companies; Echo: www.hagerco.com/#sle.

B. Hinges: Comply with BHMA A156.1, Grade 1.
1. All exterior out-swinging doors shall have butts with non-removable pins when the door is closed. Doors with closers shall have ball bearing butts.
2. Doors 1-3/4” thick and up to 40” wide to have 4-1/2” butts.
3. Doors 1-3/4” thick; 41” to 48” wide to have 4-1/2" heavy duty butts.
4. All butts shall be sized in width to clear all trim.
5. Provide hinges on every swinging door.

2.03 FLUSH BOLTS

A. Manufacturers:
1. Hager Companies: www.hagerco.com/#sle.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 3/4 inch, minimum.

2.04 EXIT DEVICES

A. Manufacturers:
1. Basis of Design: Falcon (Allegion).

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
2. Provide cylinder with cylinder dogging or locking trim.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.

5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.05 LOCK CYLINDERS

A. Manufacturers:
   1. Falcon (Allegion).

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.
   3. All locks shall have 7-pin removable core cylinders.
   4. All lock and latch sets to have 2-3/4” backset unless otherwise noted.
   5. Strikes shall be extended tips where required to protect trim from being marred by latch bolt.
   6. Wrought boxes shall be furnished with all strikes.

C. Keys, Keying, and Cores
   1. Best 7-pin removable core cylinders.
   2. Locksets and cylinders to be furnished by Sprouts Farmers Market.
   3. All cylinders for this project shall be set to a new master key system.
   4. All cylinders to be constructed master keyed prior to delivery to job site.
   5. All grand master, master and change keys shall be properly tagged for easy identification and delivered to the General Contractor for installation one (1) day prior to punch list walk-thru.
   6. Master key sets and individual keying of locks will be determined by Owner.

2.06 CYLINDRICAL LOCKS

A. Manufacturers:
   1. Basis of Design: Falcon (Allegion).

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
   1. Bored Hole: 2-1/8 inch diameter.
   2. Latchbolt Throw: 1/2 inch, minimum.
   3. Backset: 2-3/4 inch unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.07 DOOR PULLS AND PUSH PLATES

A. Manufacturers:
   1. Hager Companies; Type and Size as listed on Drawings.: www.hagerco.com/#sle.

B. Door Pulls and Push Plates: Comply with BHMA A156.6.
   1. Pull Type: Straight, unless otherwise indicated.

2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
   a. Edges: Beveled, unless otherwise indicated.
3. Material: Aluminum, unless otherwise indicated.

2.08 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Basis of Design: Falcon (Allegion).
      a. All closers are to be mounted as to be connected to Sales Area.
      b. Finish: Sprayed to match adjacent hardware.

B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.

2.09 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
   1. Glynn-Johnson, an Allegion brand: www.allegion.com/us/#sle.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
   1. Provide stop for every swinging door, unless otherwise indicated.

C. All stops (other than overhead type) shall be wall types, all as manufactured by: Hager.

2.10 KICK PLATES

A. Manufacturers:
   1. Basis of Design: Hager.

B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.11 ASTRAGALS

A. Manufacturers:
   1. Hager Companies: www.hagerco.com/#sle.

B. Astragals: Comply with BHMA A156.22.
   1. Type: Split, two parts, and with sealing gasket.
   2. Material: Aluminum, with neoprene weatherstripping.
   3. Provide non-corroding fasteners at exterior locations.

2.12 THRESHOLDS

A. Manufacturers:

1. Hager Companies: www.hagerco.com/#sle.

B. Thresholds: Comply with BHMA A156.21.
1. Type as specified on the drawings and as shown in hardware groups, sized to fit openings. Include thresholds on drawings but not listed in the hardware list.
2. Provide threshold at each exterior door, unless otherwise indicated.
3. Type: Flat surface.
4. Material: As indicated on the Drawings..
5. Threshold Surface: Fluted horizontal grooves across full width.
6. Field cut threshold to profile of frame and width of door sill for tight fit.
7. Provide non-corroding fasteners at exterior locations.

2.13 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
1. Hager Companies: www.hagerco.com/#sle.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
1. Head and Jamb Type: Adjustable.
2. Door Sweep Type: Encased in retainer.
3. Material: As indicated on the Drawings..

2.14 DOOR BOTTOMS

A. Exterior doors to have style as indicated in hardware groups.

B. Manufacturer: Hager.

2.15 PADLOCKS

A. Manufacturers:
1. Basis of Design: Falcon (Allegion).

B. Padlocks: Solid extruded brass case with shackle that locks at heel and toe.
1. Shackle Height: 3/4 inch, and width of opening is 7/8 inch.
2. Shackle Diameter: 1/4 inch.
3. Keying: 7-pin SFIC (Small Format Interchangeable Core).

2.16 LATCH PROTECTOR

A. Manufacturers:
1. Hager; Model 340D..

B. Latch Protector: Provide on door to protect latch from being tampered with while in locked position.
1. Type: Standard latch protector.
2. Material: Stainless steel.

2.17 SIGNAGE

A. Signage (Room Name Plates and Numbers): Provide on doors for individuals to easily identify room names and/or numbers.
   1. Text Required: "RESTROOM" with symbols and braille text.
   2. Material: In plastic or metal with paint used to create necessary text, adhered to door.
   3. All signs shall conform to Federal ADA Requirements. Mount all signs on wall adjacent to door servicing room. Base manufacturer: BBW (B), Quality (Q), Baldwin (B1). No metal - plastic only. (“Employees Only” and “Emergency Exit Only” signs shall be mounted on doors at 60” A.F.F. centerline.) Characters and symbols shall contrast with their background, either light characters on a dark background or dark characters on a light background.

2.18 SILENCERS

A. Manufacturers:
   1. Basis of Design: Hager.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Metal frames to have: Single doors to have 3, each jamb. Double doors to have 2, each head.
   2. Material: As indicated on the Drawings.color.

2.19 VIEWER

A. Manufacturers:
   1. Basis of Design: Hager.

B. Viewer: Provide at inside of door at eye level to see who is on outside of door, with integral door knocker.
   1. Material: Brass.

2.20 FINISHES

A. Finishes: Identified in Door Hardware Schedule.

B. SPROUTS FARMERS MARKET PROTOTYPE HARDWARE SCHEDULE
   1. Reference construction drawings for Hardware Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

E. Contractor shall install each door hardware item as indicated on the drawings, as Specified herein, and in accordance with the manufacturers written instructions.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

B. The General Contractor shall visually inspect the installation of all hardware at completion of all such installations. All discrepancies or errors in installation and operation shall be noted and referred to the architect. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Upon completion and before final inspection, the General Contractor shall certify to the architect that all hardware is properly installed according to the manufacturer’s printed instructions and is working properly and construction cores have been replaced with final Owner cores and keys.

D. Forward letter of certification in duplicate to the Architect as soon as possible after installation of all hardware.
   1. Mounting Heights: Mount door hardware units at heights indicated on Drawings or required to comply with governing regulations.

E. Standard Steel Doors and Frames: DHI’s “Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames".

F. Wood Doors: DHI WDHS.3, “Recommended Locations for Architectural Hardware for Wood Flush Doors".

3.04 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

D. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Spring Hinges: Adjust to achieve positive latching when door leaf is allowed to close freely from an open position of 30 deg.
   2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 deg, the door will take at least three (3) seconds to move to a point 3" from the latch, measured to the leading edge of the door.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 087100

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SECTION 088000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Plastic films.

D. Glazing compounds.

1.02 SUMMARY

A. This Section specifies the requirements for furnishing and installing all glass, glazing, and related items including spacers, and sealants.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all glass and glazing work, as indicated on the Drawings or as specified herein. This work shall include but not be limited to procurement and installation of glass, glazing, and associated cleaning, cutting, fitting, sealing and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.

I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

J. GANA (GIB 01-0300) - Glass Informational Bulletin (Proper Procedures for Cleaning Architectural Glass Products); 2023.

K. GANA (GIB TD-02-0402) - Glass Informational Bulletin (Heat-Treated Glass Surfaces are Different); 2023.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Environmental Product Declaration Form(s) (EPD) complying with CALGreen Building Standards, latest edition - for each type of product required to show compliance with (GWP) Global Warming Potential requirements and impact categories.

C. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

D. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

E. Shop Drawings:
   1. Clearly show layout, designation, number, type, and location required.
   2. Submit manufacturer’s specifications, recommendations and installation instructions for all materials identified herein or on the drawings.
   3. Include published data, letters of certification, or certified test laboratory reports, that all materials comply with the requirements and are intended for the applications shown.
   4. Submit manufacturer's product data sheet and glazing instructions.

F. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material test reports substantiating compliance with requirements.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Field quality control test and inspection reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Specification is based on products as manufactured by Vitro Architectural Glass, Pittsburgh, PA. Glass products by other manufacturers may be submitted for approval during bidding by the Architect subject to their meeting specification performance requirements.
   2. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
   3. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

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

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. All work under this section shall conform to local code requirements. In case of conflict, the more stringent requirements shall apply.

H. Provide glass products in the thicknesses and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on project loads and in-service conditions per ASTM E1300.
   1. Minimum thickness of annealed or heat-treated glass products is selected, so the worst-case probability of failure does not exceed the following:
      a. 8 breaks per 1000 for glass installed vertically or not over 15 degrees from the vertical plane and under wind action.
      b. 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind and/or snow.

I. Glazing for Fire-Rated Door and Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

J. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

K. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. IGMA Publication for Insulating Glass: SIGMA TM-3000, “Glazing Guidelines for Sealed Insulating Glass Units".

1.06 MOCK-UPS

A. Provide mock-up of window films.
   1. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

B. Locate where directed.

C. Mock-ups may remain as part of the Work.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 DELIVERY, STORAGE AND HANDLING

A. Where glass units will be exposed to substantial altitude changes, comply with insulating glass fabricator’s recommendations for venting and sealing.

B. Additional requirements for product delivery, storage and handling are in Section 016000.

C. Protect glass from edge damage at all times during handling, installation and operation of the building. Glass breakage during the guarantee period will be considered a form of faulty material or workmanship (resulting from edge damage) unless known to result from vandalism or other causes not related to materials and workmanship.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Installation of glass products at ambient temperature below 40 degrees F is prohibited.

B. Field measurements: Field verify measurements with drawing dimensions prior to fabrication of glass products.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: commencing on Date of Substantial Completion.
   1. Provide a written 10-year limited warranty from date of manufacture for insulating glass. Warranty covers deterioration due to normal conditions of use and not to handling, installing, protecting and maintaining practices contrary to glass manufacturer's published instructions.
   2. Provide a two (2) year warranty for other glass products unless otherwise required.

D. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - GENERAL

A. Glazing channel dimensions as indicated on the drawings are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerance. The glazier is responsible for correct glass size for each opening, within the tolerances and necessary dimensions established.

B. Examine the framing or glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed.

C. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with glazing until unsatisfactory conditions have been corrected in a manner acceptable to the Architect.

2.03 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.

1. Watertight and airtight installation of each piece of glass is required. Each installation must withstand normal temperature changes, wind loading, and impact loading (for operating doors) without failure of any kind. Failure includes loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials, and other defects in the work.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Glass and glazing shall meet the requirements of the International Energy Conservation Code (IECC) as required by the local jurisdiction for the applicable zone, including but not limited to:
   a. Winter and Summer U-Values
   b. Solar Heat Gain Coefficient (SHGC)
   c. Shading Coefficient
   d. Outdoor Visible Light Reflectance
2. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
3. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
4. Solar Optical Properties: Comply with NFRC 300 test method.

2.04 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. 1/4" thick complying with ASTM C1036, Type I, Class I, Quality Q-8, plate or float. Clear or tinted as indicated on the drawings – See elevations.
2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

B. Permanently etch each light with manufacturer's name and his compliance with ANSI Z97.1. Clear or as indicated.

2.05 INSULATING GLASS UNITS

A. Manufacturers:
1. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Spacer Color: Black.
4. Edge Seal:
   a. Color: Black.

5. Purge interpane space with dry air, hermetically sealed.

C. Clear Insulating Glass Units: Vision glass, double glazed.
1. Insulating glass units shall be as certified through the Insulating Glass Certification Council (IGCC) to ASTM E2190.
2. Glass type, tint, and gas fill (if other than air) shall be as indicated on the Drawings.
3. Applications: Exterior glazing unless otherwise indicated.
4. Space between lites filled with air.
5. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
   b. Coating: Low-E (passive type), on #2 surface.
6. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
7. Total Thickness: 1 inch.

D. Tinted Insulating Glass Units: Vision glass, double glazed.
1. Insulating glass units shall be as certified through the Insulating Glass Certification Council (IGCC) to ASTM E2190.
2. Glass type, tint, and gas fill (if other than air) shall be as indicated on the Drawings.
3. Applications: Exterior glazing unless otherwise indicated.
4. Space between lites filled with air.
5. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: As indicated on the Drawings..
   b. Coating: Low-E (passive type), on #3 surface.

2.06 PLASTIC FILMS

A. Blockout - Non-Perforated, Vinyl type.
1. Application: Locations as indicated on drawings.
2. Color: Anthracite Mettalic #093, or as noted on the Drawings.
   a. Additional colors, in order of preference (only to be used if approved by Sprouts APM in writing): Graphite Metallic #932, Black Metallic #704, or Foliage Green Metallic #679.
3. Thickness: 2.0 mils.
4. Adhesive Type: Solvent acrylic, permanent adhesive.
5. Adhesive color: clear.
6. Manufacturers:
   a. Orafol Americas, Inc.; 951 Premium Cast: 1100 Oracal Parkway, Black Creek, GA 31308; Toll Free Tel: 888-672-2251; web: www.orafol.com .
   b. Substitutions: Not permitted.

B. Additional film options to be used only when approved by Sprouts APM in writing:
1. Tint - Solar Control Plastic Film: Mylar type.
   a. Application: Locations as indicated on drawings.
   b. Manufacturers:

1) 3M Window Films; Prestige Exterior Series: 3M Commercial Solutions, 3M Center, Building 220-12E-04, St. Paul, MN 55144-1000; web: www.3M.com/windowfilm
   a) Film Type: PR20X or PR40X, to be confirmed with Sprouts APM.
2) Substitutions: Not permitted.

2. Perforated: Vinyl type.
   a. Perforated Vinyl Window Film to be supplied and installed by Sprouts Farmers Market Vendor.
   b. Application: Locations as indicated on drawings.
   c. Color: White.
   d. Thickness: Nominal 6.0 mils
   e. Adhesive Type: Solvent acrylic.
   f. Adhesive Color: Clear. (60/40) clear removable type.
   g. Manufacturers:
      1) General Formulations,; Model GF 260 Windowmark: 309 S. Union, Sparta, MI 49345; Toll Free Tel: 800-253-3664; Tel: 616-887-7387; Fax: 616-887-0537; web: www.generalformulations.com .
      2) Substitutions: Not permitted.
3. Non-Perforated: Vinyl type.
   a. Non-Perforated Vinyl Window Film to be supplied and installed by Sprouts Farmers Market Vendor.
   b. Application: Locations as indicated on drawings.
   c. Thickness: Nominal 2.95 mils
   d. Adhesive Type: Solvent acrylic, pressure sensitive.
   e. Adhesive Color: Clear.
   f. Manufacturers:
      1) Mactac,; Model JT5798MBF v2 – 3.1 Mil translucent, polymeric PVC film: 4560 Darrow Road, Stow, Ohio; Toll Free Tel: 800-321-8834; web: www.mactac.com.
      2) Substitutions: Not permitted.

2.07 GLAZING COMPOUNDS

A. Interior Glazing Compound: Polymerized Butyl Rubber and inert Fillers (pigments), solvent based with minimum 75% solids, non-sag consistency, tack-free time of 24 hours or less, paintable non-staining.

2.08 ACCESSORIES

A. Setting Blocks: Neoprene or EPDM, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Exterior glazing compound: Conforming to ASTM C920, Type S, Grade NS, Use G.

D. Butt Glazing Sealant: GE 1200 Series Silicone. (where occurs).

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Glass shall be annealed, heat-strengthened or tempered as required by codes, or as required to meet thermal stress and wind loads, whichever is most stringent. Refer to Drawings and Part 1 of this Section.

D. Film Examination:
1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
    a. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
2. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
3. Commencement of installation constitutes acceptance of conditions.

3.02 PREPARATION

A. Handle and store product according to manufacturers' recommendations.

B. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

C. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

D. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

F. Clean the glazing, channel, or other framing members to receive glass, immediately before glazing. Remove coatings that are not firmly bonded to the substrate.

G. Do not attempt to cut, seam, nip or abrade glass that is tempered or heat strengthened.

H. Comply with “Glazing Manual” by FGMA, except as shown, and specified otherwise by the manufacturers of the glass and glazing material.

I. Inspect each piece of glass immediately before installation and eliminate any that have observable edge damage or face imperfections.

J. Install setting blocks of proper size at quarter points of sill rabbet. Set blocks in this course of the heel-head compound, if any.

K. Provide spacers inside and out, and of proper size and spacing, for all glaze sizes larger than 50 united inches. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width.

L. At butt glazing; ground edges, provide 1/8" minimum space and fill with silicone sealant.

M. Unify appearance of each series of tights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other piece.

N. Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in the glazing system.

O. Protect exterior glass from breakage immediately upon installation, by attachment of crossed streamers to framing held away from glass.

P. Do not apply markers of any type to surfaces of glass.

Q. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in any other way during the construction period, including natural causes, accidents and vandalism.

R. Final installation must be completely weather tight and clean both inside and out.

3.04 INSTALLATION - WINDOW FILM

A. Install in accordance with manufacturer's instructions.

B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.

D. Apply film to glass and lightly spray film with slip solution.

E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.

F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.05 INSULATING GLASS UNIT INSTALLATION

A. Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".

B. Verify that Insulating Glass (IG) Unit secondary seal is compatible with glazing sealants.

C. Install glass in prepared glazing channels and other framing members.

D. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual and IGMA Glazing Guidelines.

E. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA Glazing Manual.

F. Provide weep system as recommended by GANA Glazing Manual.

G. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

H. Distribute the weight of the glass unit along the edge rather than at the corner.

I. Comply with manufacturers and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and bite clearances, use of glass spacers, edge blocks and installation of weep systems.

J. Protect glass from edge damage during handling and installation.

K. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

L. Remove and replace glass that is broken, chipped, cracked or damaged in any way.

3.06 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.07 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

C. Remove nonpermanent labels immediately after glazing installation is complete.

D. Clean glass and adjacent surfaces after sealants are fully cured.

E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

F. Glass to be cleaned according to:
   1. GANA Glass Informational Bulletin GANA (GIB 01-0300) - Proper Procedures for Cleaning Architectural Glass Products.
   2. GANA Glass Information Bulletin GANA (GIB TD-02-0402) – Heat-Treated Glass Surfaces Are Different.

G. Do not use scrapers or other metal tools to clean glass.

H. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 088000

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Acoustic insulation.

D. Gypsum sheathing.

E. Cementitious backing board.

F. Gypsum wallboard.

G. Joint treatment and accessories.

1.02 SUMMARY

A. This Section specifies the construction of all gypsum wallboard assemblies including gypsum wallboard installation, corner bead reinforcement, metal edge reinforcement, control joints, fasteners, adhesives, suspended ceiling components, joint treatment products, finishing materials, and sealants.

B. Contractor shall provide all labor, materials, equipment, and services necessary to provide, furnish, transport, and install all gypsum wallboard finishing work with related metal components, accessories, and finish surfaces, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and furnishing of gypsum wallboard and associated cutting, fitting, drilling, taping, fastening, sealing, and finishing.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.

B. Section 092216 - Non-Structural Metal Framing.

1.04 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).

G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

H. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2020).

I. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).

J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

M. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2024.

N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

P. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

Q. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.

R. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.

S. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).

T. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.

U. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

V. ASTM D2394 - Standard Test Methods for Simulated Service Testing of Wood and Wood-Based Finish Flooring; 2017.

W. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

X. GA-214 - Levels of Finish for Gypsum Panel Products; 2021.

Y. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

Z. GA-234 - Control Joints for Fire-Resistance Rated Systems; 2019.

AA. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.
   1. It is intended that all materials furnished be a part of a complete wall system, whether it be supplied by one or several manufacturers.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience who are skilled in this area of work, and whose projects have a record of successful in-service performance.

D. Contractor shall comply with the requirements of ANSI A108.11, Interior Installation of Cementitious Backer Units, and ASTM C475/C475M, ASTM C514, ASTM C840, ASTM C954, ASTM C1002, ASTM C1047, ASTM C1178/C1178M, ASTM C1280, ASTM C1396/C1396M, and GA-214, as applicable. In cases of conflicts the more stringent requirements shall govern.

E. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

F. Fire-rated Impact Resistant Board: Provide boards with indicated impact resistance when tested in accordance with ASTM D2394.

G. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

H. Testing: As required by the latest industry codes and standards.

I. Tolerances shall conform to industry codes and standards, except as otherwise noted.

J. All work under this section shall conform to local code requirements. In case of conflict, the more stringent requirements shall apply.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

B. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

1.07 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

D. Additional requirements for product warranties are included in Section 016000.

E. Contractor shall provide a weathertight, waterproof exterior wall system by caulking the joints or wrapping the building with Tyvek waterproof materials.

1.08 PROJECT CONDITIONS

A. Establish and maintain application and finishing environment in accordance with ASTM C840.

B. Temperature and Humidity Conditions:
1. Do not install wallboard unless installation areas comply with the minimum temperature and ventilation requirements recommended by the manufacturer.

C. Protection:
1. Protect work installed by other trades prior to work performed under this section.
2. Replace any damaged work without added cost to the Owner.

D. Provide closures for exterior openings, where required.
1. Room temperature during installation of wallboard shall not be less than 50 deg F. with adequate ventilation maintained to eliminate excessive moisture until joint compound is completely dry.
2. Protect wallboard from moisture, and replace all damaged material.

E. Provide ventilation during the following adhesives and joint treatment applications.
1. Use temporary air circulators in enclosed areas lacking natural ventilation.
2. Under slow drying conditions, allow additional drying time between coats of joint treatment.

3. Protect installed materials from drafts during hot, dry weather.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
1. Local authorities having jurisdiction.

C. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
1. ICC-ES Evaluation Report No. Current Approved Edition.

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Nonstructural Steel Framing for Application of Gypsum Board: See Section 092216.

C. Structural Steel Framing for Application of Gypsum Board: See Section 054000.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
5. USG Corporation: www.usg.com/#sle.
6. The Steel Network, Raleigh, NC (888) 474-4876. (Accessories only)
7. ClarkDietrich Building Systems, West Chester, OH (513) 870-1100. (Accessories only)
8. Fry Reglet, (800) 237-9773. (Accessories only)
9. Other manufacturers listed as members of CSSA, SSMA, or SFIA..

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Core: Moisture or mold resistant gypsum core.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
5. Thickness:
   a. Thickness: 1/2 or 5/8 inch.
   b. Length, Long Edges, Cut: Maximum permissible length, edges tapered, ends cut square.
6. Paper-Faced Products:
   a. American Gypsum Company; LightRoc Gypsum Wallboard: www.americangypsum.com/#sle.
   b. American Gypsum Company; FireBloc Type X Gypsum Wallboard: www.americangypsum.com/#sle.
   c. CertainTeed Corporation; Type C Drywall: www.certainteed.com/#sle.
   d. CertainTeed Corporation; Type X Drywall: www.certainteed.com/#sle.
   e. Georgia-Pacific Gypsum; ToughRock: www.gpgypsum.com/#sle.
   f. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com/#sle.
   g. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
   h. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Fire-Shield C 5/8" Gypsum Board: www.goldbondbuilding.com/#sle.
   i. USG Corporation; Sheetrock Brand Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
7. Mold-Resistant, Paper-Faced Products:
   a. American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
   b. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
   c. CertainTeed Corporation; M2Tech 1/2" Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
   d. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
   e. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com/#sle.
   f. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
   g. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Gypsum Board: www.goldbondbuilding.com/#sle.
   h. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
   i. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
   j. USG Corporation; Sheetrock Brand Mold Tough Firecode SCX Panels 5/8 in. (15.9 mm): www.usg.com/#sle.

C. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas including prep areas, restrooms, and similar areas as indicated on the Drawings..

2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
    a. Provide cementitious backing materials as follows where indicated to receive cement board, cement backer board, or cementitious backer board
    b. Thickness: 1/2 inch
    c. Products:
        1) James Hardie Building Products, Inc; Hardiebacker: www.jameshardie.com/#sle.
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
    a. Regular Type: Thickness as indicated on the Drawings.
    b. Products:
        1) CertainTeed Corporation; 1/2" GlasRoc Tile Backer: www.certainteed.com/#sle.
        2) CertainTeed Corporation; 5/8" GlasRoc Tile Backer Type X: www.certainteed.com/#sle.
        3) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
        4) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
        5) USG Corporation; Durock Brand Glass-Mat Tile Backerboard 1/2 in. (12.7 mm): www.usg.com/#sle.
        6) USG Corporation; Durock Brand Glass-Mat Tile Backerboard 5/8 in. (15.9 mm): www.usg.com/#sle.

D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Thickness: thickness shown on the drawings, maximum permissible lengths; ends square cut.
5. Edges: Square.
6. Sheathing Board Fasteners: ASTM C 954 and ASTM C 1002, 1 inch length for 1/2 inch sheathing board and 1-1/4 inch length for 5/8 inch thick sheathing board, Type S-12 bugle head, corrosion-resistant self-drilling steel screws.
7. Glass Mat Faced Products:
    a. American Gypsum Company; M-Glass 1/2" Exterior Sheathing: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; GlasRoc 1/2" Exterior Sheathing: www.certainteed.com/#sle.
    c. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
    d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.

e. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing 1/2 in. (12.7 mm): www.usg.com/#sle.
f. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

2.04 GYPSUM BOARD ACCESSORIES

A. General: Provide materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as indicated on the Drawings.
1. 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.
2. Fire-Resistance-Rated Assemblies: Comply with local codes and standards, and mineral-fiber requirements of assembly.

C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

D. Steel Drill Screws: Per ASTM C954 or ASTM C1002, or both with heads, threads, points and finish as recommended by the gypsum board manufacturer, unless otherwise indicated.

E. Nails: If indicated on the drawings, use as required by ASTM C514, with heads, lengths, configurations, and finish as recommended by the panel manufacturer.

F. Gypsum Board Fasteners:
1. Metal Framing: ASTM C954 and ASTM C1002, Type S-12 bugle head, corrosion-resistant self-drilling self-tapping steel screws.
a. One Layer 1/2 Inch: 1 inch.
b. One Layer 5/8 Inch: 1-1/8 inch.
c. Two Layers: 5/8 Inch: 1-7/8 inch.
2. Wood Furring: ASTM C1002, 1-1/4 inch, Type W bugle head, corrosion-resistant self-drilling steel screws.

G. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
a. Products:
1) Sheetrock Brand No. 104 Dur-A-Bead galvanized steel corner bead by USG..
2. Edge Trim: Galvanized steel casing.
a. No. 200-B, L shape by USG for tight abutment at edges.
b. No. 200-A, J shape by USG at other locations.
3. Control Joint Accessory Piece: No. 093 roll-formed zinc by ClarkDietrich or by other manufacturers listed as members of CSSA, SSMA, or SFIA.

4. Vertical Movement Joint Trim: No. DRMZ-625-200 aluminum Z shape trim by Fry Reglet.
5. Reveal Trim: Aluminum F reveal (F style zip strip) by Fry Reglet where shown on Drawings. Non-vented, 1/2 inch width, depth as shown on Drawings. Clear anodized finish.
6. Adhesive: Commercial adhesive complying with ASTM C557.

H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated at glass-mat gypsum sheathing board.
2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated for both interior and exterior (soffit) conditions.
   a. Water resistant gypsum board: As recommended by panel manufacturer.
   b. Tile Backing Panels: As recommended by panel manufacturer.
3. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   a. Prefilling: At open joints**,** rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
   c. Use setting-type compound for installing paper-faced metal trim accessories.
   d. Fill Coat: For second coat, use drying-type, all-purpose compound.
   e. Finish Coat: For third coat, use drying-type, all-purpose compound.
4. Joint Compound for Exterior Applications:
   a. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sand able topping compound.
   b. Glass-Mat Gypsum Sheathing Board requires water resistant joint compound: Tufroc 90 or as recommended by sheathing board manufacturer.
5. Joint Compound for Tile Backing Panels:
   a. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sand able topping compound.
   b. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
   c. Cementitious Backer Units: As recommended by backer unit manufacturer.

I. Laminating adhesives shall meet the requirements of ASTM C557 if required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Studs: Space studs as indicated on the Drawings.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Furring:
   1. Furring Channels:
      a. Attach vertically spaced at maximum 16 inches on center, to masonry and concrete surfaces with hammer set or powder driven fasteners staggered 24 inches on center on opposite flanges.
      b. Nest channels 8 inches at splices and anchor with 2 fasteners in each wing.
   2. Wall Furring:
      a. Secure top and bottom runners to structure.
      b. Space metal studs at maximum 16 inches on center.
      c. Furring for Fire Rating: Install metal furring as required for fire resistance ratings indicated on Drawings, and to GA-600 requirements.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Apply wallboard with long dimension at right angles to framing or furring members with all abutting ends and edges occurring over stud flanges.
   1. Use wallboard of the maximum practical length to minimize end joints.
   2. Neatly fit and stagger end joints.
   3. Arrange joints on opposite sides of the partition as to occur on different studs.
   4. Cut wallboard neatly to fit around all openings.
   5. Wallboard to extend to within 1/4" of the floor.

C. Whenever wallboard terminates against dissimilar materials or where edges of wallboard are exposed, install metal edge reinforcement as specified.
   1. At all outside corners install metal corner bead reinforcement as specified.

D. At metal studs apply wallboard using screws spaced a maximum of 12" O.C. in the field of the board and 12" on center along the abutting end joints; 8" O.C. each way at rated walls.

E. Where water-resistant wallboard is used, coat all cut edges and fastener heads with USG sheetrock water-resistant sealant.
   1. Treat all cut edges, utility holes, and joints, including those at angle intersections prior to installation.
   2. Treat fastener heads after installation.

F. At double stud partitions, such as at chases, install strips of wallboard 12" wide and of length to span the partition depth by screwing to the webs of opposing studs.
   1. Space strips approximately 42" O.C.

G. At double layer walls install base layer as specified above except install vertically over framing members. Install face layer with adhesive vertically and provide fasteners until adhesive sets.
   1. Stagger joints in face layer at least 10" from joints in base layer.
   2. At all vertical corners, provide "floating" corner installation per USG Gypsum Construction Handbook, latest edition.

H. Provide perimeter relief where non-load-bearing wallboard partitions abut structural decks or ceilings of vertical structural elements.
   1. Allow not less than 1/4", nor more than 1/2" gap between wallboard and structure.
   2. Finish edges of wallboard face layer with square-nose metal casing head and caulk space between casing bead and structure with continuous sealant bead.
   3. Attach wallboard to studs not less than 1/2" below bottom edge of ceiling track flanges and to first stud adjacent to vertical tracks.
   4. Do not attach wallboard directly to tracks.

I. Where wallboard partitions intersect masonry walls, provide control joint no less than 1/4"; nor more than 3/8" wide between wallboard and masonry.
   1. Finish exposed edges of wallboard with square-nose metal casing bead and caulk space between casing bead and masonry with continuous sealant bead.

J. Install exterior ceiling board allowing 1/16" to 1/8" space between butt ends of board.
   1. Fasten to supports with screws spaced 12" O.C. or nails spaced 8" O.C.
      a. For metal framing use 1" Type S screws.
      b. For wood framing use 1-1/4" Type W Screws or 1-1/2" galvanized box or aluminum nails.
   2. Conceal panel joints by installing panels with ends installed into aluminum H moldings.
   3. Fasten H moldings to support with screws spaced 12" O.C. or nails spaced 8" O.C.

K. Use water resistant gypsum board at wet areas including walls and ceiling in toilet rooms, janitor closets, and food prep areas as applicable and where shown.

L. Use water and fire-resistant gypsum board at locations of fire-resistive rated assemblies where water resistant gypsum board is specified.

M. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

N. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

O. Gypsum Sheathing:
1. Install gypsum board sheathing in accordance with manufacturer's published instructions.
2. Erect single layer gypsum board sheathing horizontally with attachment to firm bearing.
3. Place edge trim where gypsum board sheathing abuts dissimilar materials. Use longest practical length.
4. Using screws, attach panels in place at maximum 12 inches on center, perimeter and field, to supporting framing.
5. Protect exposed gypsum core at perimeter edges and penetrations by covering core with metal trim.

P. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
1. Seal joints, cut edges, and holes with water-resistant sealant.

Q. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
1. Seal joints, cut edges, and holes with water-resistant sealant.

R. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

S. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged, or otherwise unacceptable for use on this project.

T. Use proper dust control tools and methods when scoring, breaking, and otherwise handling gypsum board.

U. Where applicable, install ceiling panels before the installation of wall panels.

V. Erect single layer gypsum board in most economical direction in accordance with ASTM C840, with attachment to firm bearing surfaces over framing members. Do not align panel joints with edges of openings.

W. Treat cut edges, holes, fastener heads, and joints, including those at angle intersections, in water resistant gypsum board with specified joint compound. Treat prior to installation.

X. Place gypsum panels over supporting framing members with panel ends aligning and parallel with framing members. Leave bottom edge spacing above floor in accordance with GA-216. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4" to 1/2" (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

Y. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

Z. Install interior and exterior gypsum board in locations as indicated on the Drawings and as follows:
1. Regular Type, Type X, and Ceiling Type: As indicated on Drawings.
2. Moisture and Mold Resistant Type: As indicated on Drawings, on vertical surfaces only (not on ceilings).
3. Fire resistant gypsum board at locations of fire-resistive assemblies indicated on Drawings.

AA. Control Joints:
1. Leave ½” continuous opening between gypsum board panels.
2. Provide separate supports for each control joint flange.
3. Remove plastic tape after finishing with joint compound.

3.05 INSTALLATION OF SUSPENDED CEILINGS

A. Except where otherwise indicated, provide 1-1/2" main runner channels spaced on 4'-0" centers and metal furring channels spaced on not over 16" centers.
1. Neither main runners nor cross furring shall be let into or come in contact with abutting masonry walls or partitions.
2. Locate a main runner within 6" of the wall to support the ends of the furring channels, and locate hangers to support the ends of the main runners.

B. Where main runners or furring channels are spliced, overlap the ends not less than 8", and securely tie near each end of the splice with 2 loops of 16 gauge galvanized wire.

C. Suspend main runners from structure above with one No. 9 hanger wire for each 12 S.F. of ceiling area.
1. All wire hangers shall be of such length so that the lower ends may be saddle tied or wrapped around the main runners so as to prevent turning or twisting of the runners.

D. At steel beams, joists or other steel construction wrap hangers around, inset through, or clip or bolt to the supports, so as to develop the full strength of the hangers.

E. Securely clip metal furring channels to main runners using furring channel clips or saddle tie with 2 strands of 16 gauge tie wire. Install furring channel clips on alternate sides of the main runner channel.

F. At lights or other openings that interrupt the main runner or furring channels reinforce grillage with 3/4" cold rolled channels, wire tied atop and paralleled to the main runner channels.

G. Apply wallboard with long dimension at right angles to the furring channels, with all abutting ends and edges occurring over the web surface of the furring channel.
1. Use wallboard of maximum possible length to minimize end joints.

2. Neatly fit and stagger end joints.
3. Install wallboard with 1-5/8" screws spaced 8" O.C. in the field of the board, at all bearings, and along abutting edges.
4. Install control joints as specified below for walls.
5. Comply with Seismic Requirements where indicated on the Drawings.

3.06 INSTALLING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Install panels in accordance with manufacturer’s written instructions, and local codes and standards.

B. Apply panel’s perpendicular to supports, with end joints staggered and located over supports
1. Install with 1/4" (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.07 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.08 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Install joint treatment in accordance with GA-216.

D. Install corner bead, trim, and casing in accordance with GA-216.

E. 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.

F. Prefill open joints, rounded or beveled edges, and damaged surface areas.

G. Reinforce wall and ceiling angles and inside vertical corner angles with tape folded to conform to the adjoining surface and to form a straight, true angle.

H. Apply gypsum board finish in accordance with manufacturer's published instructions and GA-214 finish levels, and as indicated on the Drawings.

I. Apply a thin uniform layer of compound, approximately 3" wide, under and over the tape in the angle joint to be reinforced.
   1. Center tape over all joints to be reinforced and seal into the compound, leaving sufficient compound under the tape to provide proper bond.
   2. Apply a skim coat of compound immediately after embedding tape.
   3. Clean excess compound from the wallboard surface.
   4. After drying, cover embedding compounds with an additional coat of compound.

J. Allow joints to dry thoroughly (minimum of 24 hours) between each application of compound.

K. All joints shall have tape embedded, filled and finished using specified compound.

L. Cover fill coat with compound spread evenly over and slightly beyond the tapered edge of the board, feathered at the edges, with a smooth uniform slight crown over the joint.

M. All dimples at fastener heads shall receive 3 coats of compound in succession as used in joints.

N. Conceal flanges of all metal corner and edge reinforcing by at least two (2) coats of compound. When completed, the compound shall extend approximately 8" to 10" on either side of the exposed metal nosing.

O. Sand all coats as necessary after each application of compound has dried. The final coat and subsequent sanding shall leave all wallboard and treated areas uniformly smooth and ready to receive decoration, to the extent that after painting of wallboard there shall be no distinguishable difference in appearance between taped and untaped surface.

P. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

Q. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

R. Install control joints full height of partition with 1/2 inch gap between board edges and between studs. Control joints shall be installed in accordance with the gypsum manufacturer’s recommended guidelines for control joints or the Gypsum Association GA-234 for control joint in fire rated systems. Apply sealant at base of joint and control joint accessory piece at face. Install control joints at the following locations:
   1. Where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
   2. At pairs of doors, install vertical control joint at each jamb. At single doors, install control joint at latch side of jamb.

3.09 LEVELS OF GYPSUM BOARD FINISH

A. Gypsum Board Finish Levels: Finish panels to levels as indicated on the drawings, as outlined below, and according to ASTM C840.
   1. Primer and its application to surfaces are specified in other Division 9 Sections.

B. Level 0: No taping, finishing, or accessories required.

C. Level 1: All joints and interior angels shall have tape set in joint compound.
   1. Surface shall be free of excess joint compound.
   2. Tool marks and ridges are acceptable.
   3. Provide at unfinished locations (i.e., above ceilings, in attics, and similar locations not exposed in finished project).

D. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. (Water resistant gypsum backing board scheduled to receive tile).
   1. Fastener heads and accessories shall be covered with a coat of joint compound.
   2. Surface shall be free of excess joint compound.
   3. Tool marks and ridges are acceptable.
   4. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
   5. Provide as substrate for wall paneling, tile, and where noted as unfinished in locations exposed in finish project.

E. Level 3: All joints and interior angles shall have tape embedded in joint compound and one additional coat of joint compound applied over all joints and interior angles.
   1. Fastener heads and accessories shall be covered with two (2) separate coats of joint compound.
   2. All joint compounds shall be sanded smooth and free of tool marks and ridges.
   3. Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes. (See painting/wall covering specification in this regard).
   4. Provide at exposed locations receiving heavy textures.

F. Level 4: All joints and interior angles shall have tape embedded in joint compound and two (2) separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles.
   1. Fastener heads and accessories shall be covered with three separate coats of joint compound.
   2. All joint compounds shall be sanded smooth and free of tool marks and ridges.
   3. Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes. (See painting/wall covering specification in this regard).
   4. Provide at exposed locations receiving wall coverings, light textures, or flat paint.

G. Level 5: All joints and interior angles shall have tape embedded in joint compound and two (2) separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles.
   1. Fastener heads and accessories shall be covered with three separate coats of joint compound.
   2. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface.
   3. The surface shall be sanded smooth and free of tool marks and ridges.
   4. Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of finish paint. (See painting specification in this regard).

5. Provide at sanitary rooms, open-food preparation/handling spaces meeting health regulations, and all other gypsum board locations. NOTE: Provide “Level 5” at critical or severe lighting locations.

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.10 INSTALLATION OF TILE BACKER PANELS

A. Water-Resistant Gypsum Backing Board:
1. Install at wet areas where indicated.
2. Install with 1/4" (6.4-mm) gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11 at locations indicated to receive tile.

C. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

E. Verify framing does not vary more than 1/4".

F. Use maximum lengths possible to minimizing joints.

G. Attach sheathing to framing with screws at 8” O.C. at perimeter and in field.

H. Apply joint tape over joints and embed in setting type joint compound.

I. Provide finish equal to Level 4 gypsum board finish.

3.11 EXTERIOR SHEATHING

A. Glass-Mat, Water-Resistant Backing Panel.

B. Comply with manufacturer's written installation instructions and install at locations indicated to receive brick or other veneer or E.I.F.S.
1. Install with 1/4" gap where panels abut other construction or penetrations.
2. Finish joints with 2” wide 10 x 10 glass mesh joint tape and water-resistant joint compound such as Tufroc 90 or caulk all joints with GE Silpruf joint sealant to provide moisture-proof sheathing system.

3.12 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. Gypsum panel surfaces should be isolated with control joints or other means where:
   1. Partition, furring or column fireproofing abuts a structural element (except floor) or dissimilar wall or ceiling.
   2. Ceiling or soffit abuts a structural element, dissimilar wall or partition or other vertical penetration.
   3. Construction changes within plane of partition or ceiling.
   4. Partition or furring run exceeds 30’-0".
   5. Ceiling dimensions exceed 50’-0" in either direction with perimeter relief, 30’-0" without relief.
   6. Exterior soffit exceeds 30’-0" in either direction.
   7. Wings of “L”, “U” and “T”-shaped ceiling areas are joined.
   8. Expansion or control joints occur in the exterior wall.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. Bullnose Bead: Use at outside corners, and where indicated on the drawings.
   3. LC-Bead: Use at exposed panel edges.
   4. L-Bead: Use where indicated on the drawings.
   5. U-Bead: Use at exposed panel edges.
   6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.13 FIELD QUALITY CONTROL

A. Inspect metal framing erection, placement, spacing, fasteners, and connections to building.

B. Inspect gypsum board installation, fastener type, spacing, and finish level.

C. Inspect installation of firestopping penetrations of fire-restive rated partitions and at voids between top of partition and building structure.

3.14 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.15 Protection

A. Protect installed gypsum board assemblies from subsequent construction operations.

B. Protect installed products from damage and deterioration 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 092116

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SECTION 092216
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Framing accessories.

1.02 SUMMARY

A. This Section specifies the construction of all light gauge framing and bracing assemblies for interior walls and ceilings including installation, studs, bridging, connectors, runners, furring channels, wallboard, and fasteners.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all steel bracing and framing work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of steel members, and associated reinforcing, support of other work, cutting, fitting, fastening, cleaning, and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Requirements for structural, load-bearing, metal stud framing and exterior wall stud framing.

B. Section 054000 - Cold-Formed Metal Framing: Execution requirements for anchors for attaching work of this section.

1.04 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2024.

D. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2025.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.

K. ASTM E413 - Classification for Rating Sound Insulation; 2022.

L. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

M. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

1.05 ALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance with minimum five years documented experience and approved by manufacturer.

B. ASTM C754 and ASTM C645 govern installation of steel framing and furring work herein. In case of conflicts, the more stringent requirements shall govern.
   1. Protective coatings shall comply with ASTM A123/A123M, with zinc coating on exterior applications.

C. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: As required by the latest industry codes and standards.

G. Fire Test Response Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by a testing and inspection agency.

H. Sound Transmission Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a testing and inspection agency.

I. Tolerances shall conform to industry codes and standards, except as otherwise noted.

J. All work under this section shall conform to local code requirements. In case of conflict, the more stringent requirements shall apply.

1.06 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

C. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: www.clarkdietrich.com/#sle. Phone:(513) 870-1100.
2. MarinoWARE: www.marinoware.com/#sle. Phone: (800) 627-4661.
3. The Steel Network, Inc: www.SteelNetwork.com/#sle. Phone: (888) 474-4876.
4. Cemco Steel, Ft. Worth, TX (817) 568-1525.
5. Telling Industries, LLC Willoughby, OH (866) 372-6384.
6. Other manufacturers listed as a member of CSSA, SSMA or SFIA..
7. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

A. ASTM C645 and ASTM C754; galvanized sheet steel, channel shaped, 1-1/4-inch flange width, punched for utility access, depth and gages as indicated below unless otherwise indicated on Drawings
1. Interior Nonload-Bearing Partition Framing: ASTM C645 and ASTM C754; galvanized sheet steel, channel shaped, 1-1/4-inch flange width, punched for utility access, depth and gages as indicated below unless otherwise indicated on Drawings.

Stud Depth:	Partition Height / Unsupported Length*	Minimum Guage (mil)	Max Stud Spacing (Center to Center)
3-5/8 inches	Up to 8'-0"	25 gauge (18 mil)	24 inches
3-5/8 inches	Up to 13'-4"	20 gauge (30 mil)	24 inches
3-5/8 inches	13'-4" to 16'-3"	20 gauge (30 mil)	16 inches
6 inches	Up to 18'-9"	20 gauge (30 mil)	24 inches

6 inches	18'-9" to 23'-4"	20 gauge (30 mil)	16 inches
*Heights/Lengths outside these limits will require additional bracing. Reference Drawings for details.			

2. Partition Studs: C-shaped with flat faces.
   a. ASTM C645; galvanized sheet steel, channel shaped, same depth and gage as studs, tight fit; solid web.
3. Partition Runners: U-shaped, sized to match studs.
   a. ASTM C645; galvanized sheet steel, channel shaped, same depth and gage as studs, tight fit; solid web.
4. Ceiling Joists, Tracks, Headers at Partition Openings, Framing Attachment Angles, and Fasteners: Specified in Section 054000.

B. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
1. ASTM C645; deep-leg U-shaped steel track at roof deck or structure, of web depth as shown to contain studs while allowing free vertical movement indicated.
   a. VertiClip or VertiTrack by The Steel Network. If this option is used, track may be 20 gauge (30 mil) for all stud sizes.
   b. FastTop Clip by ClarkDietrich.
   c. SLP-TRK by Brady Innovations as distributed by Cemco.
   d. Comparable modified deflection tracks by other manufacturers listed as members of CSSA, SSMA, or SFIA.

C. Furring and Bracing: ASTM C645; galvanized sheet steel.
1. Studs: ST25 - 2-1/2 inch deep, 25 gage (18 mil).
2. Studs: ST25 - 3-5/8 inch deep, 25 gage (18 mil).
3. Resilient Furring Channels: 1/2 inch deep x 2-1/2 inch wide, 25 gage (18 mil)
4. Hat-Shaped Channels: 7/8 inch deep x 1-1/2 inch wide, 25 gage (18 mil) or 1-1/2 inch deep x 2-1/2 inch wide (30 mil) as shown on the drawings.
5. Cold-Formed Channels: 3/4 x 1/2 inch and 1-1/2 x 17/32 inch, 16 gage (54 mil).
6. Z Furring Channel: 1-1/2 inch deep, 25 gage (18 mil).
7. Clip Angles: 2 inches x 2 inches x 16 gage (54 mil) x 1/4 inch less than stud width.
8. Contractor's Option: In lieu of cold-formed channels and clip angles for horizontal wall bridging, Contractor may provide one of the following:
   a. Bridge Bar by The Steel Network.
   b. TradeReady Spazzer 9200 Bridging and Bracing Bar by ClarkDietrich.
   c. Comparable products by other manufacturers listed as members of CSSA, SSMA, or SFIA.

D. Non-Loadbearing Framing Accessories:
1. Partition Framing Fasteners: Corrosion-resistant self-drilling self-tapping steel screws.
   a. Provide 22 Gage (27 mil) Framing: ASTM C1002; 3/8 inch Type S pan head.
   b. Provide 20 Gage (30 mil) and Heavier Framing: ASTM C954; 5/8 inch Type S-12 low-profile head.

2. Bracing to Framing Attachment Angle Fasteners: #12 diameter pan head corrosion-resistant self-drilling screws.
3. Partition Floor Track Anchorage Device: Low velocity powder-actuated drive pins; minimum 0.138 inch shank diameter x 1-1/2 inch shank length with 7/8 inch diameter washer.
    a. Hilti PAT System using X-C 37 P8S36 Pins, by Hilti, Tulsa, OK. Phone: (800) 879-8000.
    b. Ramset/Red Head System using 1500SD Pins, by ITW Ramset/Redhead, Wood Dale, IL. Phone: (630) 350-0370.
4. Wall Furring to Concrete or Masonry Wall Fasteners: Hex head sleeve anchors; minimum 1/4 inch diameter x minimum 1-1/8 inch embedment.
    a. Slv Anch HLC-HX 5/16 x 2-5/8, by Hilti, Tulsa, OK, Phone: (800) 879-8000.
    b. Dynabolt HN-1413, by ITW Ramset/Redhead, Wood Dale, IL, Phone: (708) 350-1558.
5. Furring Channel to Masonry or Concrete Surface Fasteners: Low velocity powder-actuated drive pins of size to suit application.
6. Flat Straps and Plates: ASTM A653/A653M; galvanized sheet steel, gage, shape, and configuration as indicated on Drawings.
    a. Contractor's Option: In lieu of 2-inch continuous metal strap at deflection tracks, Contractor may provide one of the following:
        1) Bridge Bar by The Steel Network.
        2) TradeReady Spazzer 9200 Bridging and Bracing Bar by ClarkDietrich.
        3) Comparable products by other manufacturers listed as members of CSSA, SSMA, or SFIA.

E. Auxillary Materials:
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
2. Isolation Strip at Exterior Walls: Provide one of the following:
    a. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), non-perforated.
    b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8" thick, in width to suit steel stud size.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

C. Examine existing conditions and adjacent areas where products will be installed and verify that conditions conform to product manufacturer's requirements. Verify that building framing components are ready to receive Work. Verify that rough-in utilities are in-place and located where required. Do not proceed until unsatisfactory conditions have been corrected.

D. Examine panels to assure they are dry and free of moisture and mold damage as evidenced by discoloration, sagging, irregular shape, fuzzy or splotchy surface contamination, and discoloration.

3.02 INTERFACE WITH OTHER WORK

A. Coordinate erection of studs with hollow metal door and window frames, sliding window, and overhead coiling door frames.

B. Coordinate installation of anchors, supports, and blocking for mechanical, electrical, and building accessory items installed within framing.

3.03 INSTALLATION OF STUD FRAMING - GENERAL

A. Installation Standards: Comply with ASTM C754 and ASTM C840 requirements that apply to framing installation and with further details and instruction by gypsum board manufacturer's written construction guidelines.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with USG's "Gypsum Construction Handbook."

3.04 INSTALLATION OF STUD FRAMING

A. Install studs and fasteners in accordance with manufacturer's published instructions, ASTM C754, GA-216, and GA-600.

B. Install bracing at terminations in assemblies.

C. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

D. Install studs so flanges within framing system point in same direction.

E. Metal Stud Spacing: Unless otherwise noted on Drawings, provide interior framing at maximum spacing specified herein in Part 2 for framing materials. Provide 16 inches on center maximum spacing for walls to receive ceramic tile.

F. Align stud web openings horizontally.

G. Splice studs with minimum 8-inch nested lap, fasten each stud flange with minimum two screws.

H. Place studs as indicated on Drawings, minimum 2 inches from abutting walls.

I. Install headers and jambs at partition openings using load-bearing C-shaped studs as noted on drawings and as specified in Section 054000.

J. Install framing between studs for attachment of mechanical and electrical items.

K. Install intermediate studs above and below openings to match wall stud spacing.

L. Install tracks (runners) at floors and overhead supports. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through ceiling to building structure above.

M. Maintain clearance under structural members to avoid deflection transfer to studs.
   1. Where indicated, construct partition to accommodate vertical deflection.
   2. Install optional products by The Steel Network specified in Part 2 above in accordance with manufacturer's printed instruction.
      a. Install clip with step bushing in center of slotted hole.
      b. Use a minimum of two fasteners per clip leg to connect clip to structure and partition framing.
      c. Attach clip to each stud by screwing through the center of each step bushing.

N. Fasten studs adjacent to door and window frames, partition intersections, and corners to top and bottom runner flanges in double-stud fashion with metal lock fastener tools.
   1. Securely fasten studs to jamb and head anchor clips of door and borrowed-light frames.
   2. Place horizontally a cut-to-length section of runner with web-flange bend at each end. Fasten with minimum one screw per flange.
   3. Position a cut-to-length stud (extending to top runner) at vertical panel joints over door frame header.

O. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

P. Align stud web openings horizontally.

Q. Secure studs to tracks using crimping method. Do not weld.

R. Fabricate corners using a minimum of three studs.

S. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

T. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

U. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

V. Lateral Bracing for Metal Studs:
   1. In metal stud partitions and bulkheads where length of metal studs is over 8 feet, install lateral bracing using one of the following methods:

a. Install 1-1/2 inch cold-rolled channel through stud web holes and screw attach in place with clip angles. Lap channels by nesting one inside the other to a depth of at least 8 inches and wire tie together.
b. Install optional Bridge Bar by the Steel Network specified in Part 2 above in accordance with the manufacturers printed instructions.
c. Install field-cut runner for solid bridging at each end of wall, adjacent to wall openings, and 10 feet on center maximum. Install 1-1/2 inch wide, 20 gage (30 mil) strap bracing on both sides of stud. Fasten strap bracing to each solid bridging runner section with four screws.

2. Gypsum Board Partitions: Space lateral bracing at the following intervals:
   a. Partitions sheathed with gypsum board full height, each side: Provide bracing at mid-height.
   b. Partitions sheathed with gypsum board partial height (one or both sides): Provide bracing at 48-inches on center for unsheathed height of partition.
3. Wire Mesh Partitions: Space lateral bracing at the following intervals:
   a. Stud Length Greater Than 8 Feet: Provide bracing at 60 inches on center.
   b. Stud Length Greater Than 10 Feet and Up To 15 Feet: Provide bracing at third points.
   c. Stud Length Greater Than 15 Feet and Up To 20 Feet: Provide bracing at quarter points.

W. Install braced framing of steel stud framing as indicated on Drawings. Use only screw attachments.

X. Blocking: Screw attach wood blocking between studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories and hardware.

Y. Framing Fastening: Fasten framing in accordance with manufacturer's published instructions and the following schedule, unless indicated otherwise on Drawings.

Connection	Fastener
Floor Track to Concrete	1 - Pin at 32 inches on center
Partition Stud to Floor Track	1 - Screw each side at each flange
Stud Brace Web to Stud Web	2 - Screws
Plates and Straps to to Studs	2 - Screws
Stud Web to Stud Web	2 - Screws
Stud Brace Web to Attachment Angle	2 - Screws
Lateral Bracing to Partition Stud Using Clip Angles	2 - Screws to stud and 2 - Screws to cold rolled channel
Runner to Header	1 - Screw at 16 inches on center, maximum 6 inches from each end

3.05 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

E. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

H. Laterally brace suspension system.

3.06 INSTALLATION - FURRING

A. Furring Channels:
   1. Attach vertically spaced at maximum 16 inches on center, to masonry and concrete surfaces with hammer set or powder driven fasteners staggered 24 inches on center on opposite flanges.
   2. Nest channels 8 inches at splices and anchor with 2 fasteners in each wing.

B. Wall Furring:
   1. Secure top and bottom runners to structure.
   2. Space metal studs at maximum 16 inches on center.
   3. Furring for Fire Rating: Install metal furring as required for fire resistance ratings indicated on Drawings, and to GA-600 requirements.

END OF SECTION 092216

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SECTION 093000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Ceramic accessories.

1.02 SUMMARY

A. This Section specifies the construction of all ceramic and porcelain tile, and related items including installation of tile, grout, mortar, portland cement, underlayment, backer board, leveling compound, crack suppression membrane, waterproofing, substrate repair materials, reinforcement, membranes, expansion joints, adhesives, and sealants.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, receive, and install all ceramic and porcelain tile and related work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and procurement of tile and associated mortaring, grouting, floor preparation prior to installation (including removal of existing flooring if required) cutting, sanding, grinding, priming, fitting, cleaning, sealing and protection.

C. Inspect surfaces to receive tile before starting installation, Notify the Architect in writing of any defects or conditions that will prevent satisfactory tile installation. Starting of work will imply acceptance of surfaces to receive tile.

D. Close areas in which tile is being set to traffic and other work, Keep closed until tile is firmly set, minimum time of 72 hours. Protect tile work from damage until acceptance.

E. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section 092116 - Gypsum Board Assemblies: Tile backer board.

1.04 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

C. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.

D. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.

E. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.

F. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

G. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

H. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

I. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

J. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation; 1999 (Reaffirmed 2021).

K. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

L. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).

M. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.

N. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.

O. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

P. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

Q. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

R. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

S. ISO 13007-2 - Ceramic Tiles - Grouts and Adhesives - Part 2: Test Methods for Adhesives; 2013.

T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

U. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.
   1. Materials, preparation, and installation shall conform to ANSI Standards as listed, and the detailed installation instructions of the material manufacturer as applicable.

C. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial B Contractor, light commercial: www.naturalstoneinstitute.org/#sle.
   1. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a five (5) year past record of successful in-service performance.

D. Installer Requirements:
   1. Installation of Ceramic Tile shall be with Latex Portland Cement Mortar in accordance with ANSI A108.1a and ANSI A108.5.
   2. Installation of Ceramic Tile shall be with Organic Adhesive (interior applications only) in accordance with ANSI A108.4.
   3. Installation of porcelain tile shall be with epoxy portland cement mortar and adhesive in accordance with ANSI A137.1, ANSI A118.3 and ANSI A118.5.

E. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

F. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

G. Testing: As required by the latest industry codes and standards.

H. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

C. Deliver tile to the job in original sealed, undamaged, unopened cartons, with identification labels intact, a grade seal bearing name of manufacturer and brand, and the words “Standard Grade” printed thereon.

D. Manufactured mortars and grouts shall contain hallmark certifying compliance with referenced standards and be types recommended by tile manufacturer for specific applications.

E. Adhesives shall be in containers labeled with hallmark certifying compliance with referenced standards.

F. Organic adhesive containers to bear hallmark of either adhesive and sealant council or TCNA (HB) certifying compliance with ANSI A108.4 and ANSI A118.3.

G. Deliver mastic grout ready for use.

H. Deliver epoxy grout in new (unopened) sealed, moisture-proof containers / packages.

I. Deliver dry-set mortar in sealed, moisture proof containers.

J. Ordering: Comply with Sprouts contracted supplier’s ordering instructions and lead time requirements to avoid construction delays.

K. Additional requirements for product delivery, storage and handling are in Section 016000.

1.07 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (and rising) and below 100 degrees F during installation and curing of setting materials.

C. Comply with minimum temperature recommendations of manufacturer’s instructions for bonding and grouting materials in other than portland cement mortar.

D. Protect adjoining work surfaces before tile work begins.

1.08 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

C. Additional requirements for product warranties are included in Section 016000.

PART 2 PRODUCTS

2.01 TILE

A. All tile shall be of domestic manufacture, Standard Grade, meeting the requirements of SPR-R-61 of the U.S. Department of Commerce, and in accordance with ANSI A137.1 . TCNA certification mark shall appear on each carton label.

B. Provide tile materials and accessory materials in accordance with TCNA standards and requirements.

C. Ceramic Tile: ANSI A137.1 standard grade.
   1. Floor tile shall be Standard Grade, Unglazed Dust-Pressed Porcelain Type, not less than 1/4” thick, with cushion edges and in nominal face sizes as noted on drawings in colors as selected. Tile shall comply with Section 5.1 of ANSI A137.1. Provide all necessary shapes and trimmers of similar tile as required.
   2. Wall tile shall be Standard Grade Glazed Tile with cushion edges, a colored matt glazed finish and in nominal face sizes as noted on drawings. Provide spacer lugs or other similar features on edges of tile. Tile shall comply with Section 6.1 of ANSI A137.1. Provide A-3401 base member at junction of floor and at internal corners; ABL/R 3401 and ACL/4 3401 as applicable. Provide non-sagging mortar for tile installations on walls.
   3. Size: As indicated on the Drawings.
   4. Edges: Cushioned.
   5. Color(s): As indicated on drawings.
   6. Products:
      a. As indicated on the Drawings..
   7. Latex Portland Cement: ASTM C150, Type I.
   8. Aggregate: ASTM C144 for mortar and grout.
   9. Hydrated Lime: ASTM C206 or C207, Type S.
   10. Water: Potable.
   11. Reinforcing: 2” x 2” - 16/6 gauge welded wire mesh (where suggested by manufacturer or TCNA).
   12. Membrane: (where suggested by tile manufacturer or TCNA).
   13. Interior Glazed Tile Grout: Color and Manufacturer as indicated on Plans.
   14. Latex Portland Cement Mortar meeting ANSI A118.4 and ISO 13007-2; C2E shall be Laticrete 255 Multimax, single component, factory blended, polymer modified, dry-set mortar.
   15. Organic Adhesive:ANSI A136.1 , Type I.
   16. Expansion Joints (includes control, contraction and isolation joints).
   17. Back-Up: Flexible compressible type of closed-cell foam polyethylene or butyl rubber, rounded at surface to contact sealant, as shown in TCNA details, and as recommended by sealant manufacturer. It shall fit neatly into the joint without compacting and to such a height to allow a sealant depth of 1/2 the width of the joint. Sealant shall not bond to the back-up material.

D. Porcelain Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

2. Size: 8 by 8 inch, nominal.
3. Thickness: 5/16 inch.
4. Surface Finish: As indicated on the Drawings..
5. Color: As indicated on drawings.
6. Pattern: As indicated on the Drawings..
7. Joint width between tiles shall be as shown on Finish Schedule and as recommended by manufacturer.
8. Base shall be 6” high, 8” wide, 5/16" coved base with coved top, trims, inside base, corner coves, etc. as indicated on Plans.
9. Products:
   a. As indicated on the Drawings..
10. Grout material shall be Epoxy: Laticrete Spectralock 2000 IG, 100% solids, industrial grade epoxy grout with high chemical and stain resistance, color as indicated on Plans.
11. Grout shall conform with ANSI A118.3 and ISO 13007-2; RG.
12. Provide flexible sealant at edges between tile and metal edge where it abuts concrete floor / transition as detailed on plans.
13. Latex Portland Cement Mortar meeting ANSI A118.4, ANSI A118.11, ANSI A118.15 and ISO 13007-1; C2E shall be Laticrete 254 Platinum Plus, single component, factory blended, polymer fortified, thin-set mortar.
14. Contractor shall provide porcelain tile manufacturer’s recommended water-based sealer for porcelain tile or other sealer as required by the Health Department having jurisdiction.

2.02 TRIM AND ACCESSORIES

A. Thresholds: Provide transition pieces (provide samples) between adjacent floor finishes. Bevel edges at least 1:2 slope, limit height of bevel to 1/2" or less, and finish bevel to match face of threshold.

2.03 SETTING MATERIALS

A. Reference requirements for each type tile in above sections.

2.04 GROUTS

A. Reference requirements for each type tile in above sections.

2.05 ACCESSORY MATERIALS

A. Waterproof and crack suppression membranes for thin-set tile installation: Laticrete, as recommended by manufacturer.

B. Cementitious Backer board:
   1. Per ANSI A118.9 in maximum lengths available to minimize end-to-end buff joints.
   2. Thickness: minimum 1/4", as indicated on drawings, or as required by tile manufacturer, codes, and standards.

C. Sealant:

1. One part, mildew resistant silicone complying with ASTM C920, Type M, Class 25, Grade NS for Uses NT, G, and A, and as applicable to nonporous joint substrates indicated.
2. Use two part pourable urethane sealant for Use T in accordance with ASTM C920, Type M, Grade P, Class 25, Uses T, M, A, and as applicable to joint substrates indicated.
3. Grout sealer shall not change color or appearance of grout.

D. Deli Base Angle: Stainless steel base angle at flooring transition at Deli cases.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 GENERAL

A. Comply with ANSI A108, “Specification for Installation of Ceramic Tile” and TCNA (HB) TCNA Installation Guidelines:
   1. TCNA (HB)’s Handbook for Ceramic Tile Installation, for installation of ceramic tiles and accessories.

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. Grind cut edges of file abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area to provide minimum half tile at inside and outside corners. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

E. Locate expansion joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

F. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets concrete, carpet, wood, or other flooring that finishes flush with top of tile.

G. Grout tile to comply with ANSI A108.6. At wet areas where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11. Install waterproofing to comply with ANSI A108.13, and waterproofing manufacturer’s instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

H. Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer’s written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.03 PREPARATION

A. Vacuum clean surfaces and damp clean.

B. Seal substrate surface cracks with filler.

3.04 CERAMIC AND PORCELAIN TILE PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions.

C. Remove protrusions, bumps, and ridges by sanding or grinding.

D. Prior to installation, open all tile containers/boxes and hand select tiles to eliminate defects on the face of tiles and insure there is a uniform finish on exposed edges of tiles. Unfinished (chattered) edges that will not be embedded into the grout are unacceptable. All tile that have blemishes and do not have uniform edges are to be returned to the supplier or manufacturer as unacceptable. Any tiles that have been installed that have defects on the face of the tiles or unglazed exposed edges will be unacceptable and are to be removed and replaced prior to building acceptance/turnover.

E. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

F. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

G. Tile edges to which the sealant will bond must be clean and dry. Sand or grind as necessary to obtain optimum sealant bond.

H. Prime tile edges when recommended by the sealant manufacturer. Take care to keep primer off tile faces.

3.05 INSTALLATION - GENERAL

A. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

B. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

C. Form internal angles square and external angles bullnosed.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of file abutting trim, finish, or built-in items. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Install ceramic accessories rigidly in prepared openings.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated on drawings.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.
   1. Provide expansion joints if required per manufacturer's recommendations.
   2. Locate expansion joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

J. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

K. Set back-up when mortar is placed or utilize removable wood strip to provide space for back-up after mortar has cured.

L. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

M. Grout tile joints flush with face of tiles making a neatly finished smooth surface.
   1. Install specified grout in strict accordance with manufacturer's printed instructions.
   2. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
   3. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

N. Grout tile to comply with ANSI A108.6. At wet areas where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11. Install waterproofing to comply with ANSI A108.13, and waterproofing manufacturer's instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

O. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

P. Install sealant after tile work and grout are dry.
   1. Follow sealant manufacturer's recommendations.

3.06 MIXING AND APPLICATION

A. Use appropriate safety equipment. Refer to Material Safety Data Sheet (MSDS) for more information.

B. Always mix complete units. Partial mixing will result in uncured grout. Do not add other materials to this mixture.

C. In a clean container, mix all of Part A and all of Part B. Allow enough time for all the material in the Part A and Part B containers to flow completely out. Mix using a low-speed mixer at about 300 rpm until a homogenous, consistent color is obtained. Do not over mix.

D. Add Part C (powder) to the Part A and Part B mixture. Mix using a low-speed mixer at about 300 rpm.

E. Mix thoroughly until a homogenous, consistent color is obtained.

F. Avoid prolonged mixing, which may cause air entrapment and shorten the pot life.

G. Do not place the lid on the container after material has been mixed.

H. The temperature of the tile work must be maintained at between 35 deg F and 90 deg F (2 deg C and 32 deg C) while grouting and until epoxy grout has hardened sufficiently (after 24 to 72 hours).

I. Application and cleanup procedures for an entire unit should be completed in about 45 minutes to 1 hour at 73 deg F (23 deg C).

J. Be certain that all joints are well-compacted and are free of voids and gaps. Fill the joints with the maximum amount of grout possible.

3.07 INSTALLATION - FLOOR TILE

A. Install floors using portland cement mortar in accordance with ANSI A108.1a and TCNA (HB) methods F-111-85 (over precast concrete) or F-112-85 (over cast-in-place concrete). Membrane is to be furnished and installed as a part of the work of this Section (method F-111) just prior to tile installation.

B. Install floors using Latex Portland Cement mortar in accordance with ANSI A108.1a and TCNA (HB) method F-113-85.

C. Grout tile with specified grout, slightly depressed.

D. Slope floors uniformly to floor drains where required.

E. Provide expansion joints, control joints, contraction joints, and isolation joints in accordance with TCNA (HB) Method EJ-711-85.

3.08 INSTALLATION - WALL TILE

A. Install wall tile in cement mortar in accordance with ANSI A108.5 and TCNA (HB) methods W-241-85 (metal studs) or W-212-85 (masonry or concrete). Metal lath and scratch coat over metal studs is specified in other Sections of these Specifications.

B. Install wall tile in organic adhesive in accordance with ANSI A108.4 and TCNA (HB) methods W-242-85 (metal studs) or W223-85 (masonry and concrete).

C. Align all joints in wall tile vertically and horizontally.

D. Grout all tile with specified grout.

E. Provide expansion joints, control joints, contraction joints and isolation joints in accordance with TCNA (HB) Method EJ-711-85.

3.09 CLEANING

A. Clean tile and grout surfaces and protect from other trades. Cure all ceramic tile floors for a minimum of 72 hours.

B. Thoroughly remove excess epoxy grout from the face of the tile before the epoxy loses its plasticity or begins to set. This is most easily accomplished by holding the rubber float at a 90 deg angle to the tile surface and dragging the float across the tile surface diagonally to the grout line, leaving as little epoxy on the tile surface as possible.

C. Clean tiles immediately after applying each unit of epoxy grout. Grout and clean in small areas. Do not attempt to use more than one (1) unit before cleaning tiles. Do not allow epoxy grout to harden on the tile surface. On large projects, working in teams of 2 to 3 people will simplify the installation.

D. Apply a liberal amount of cold water to the freshly grouted area and scrub the tile surface diagonally to the joint line using a non-woven nylon white scouring pad (use a more aggressive pad if tile type is abrasive). Apply enough pressure on the pad to loosen any film without removing grout from the joints. Rinse pads frequently while cleaning. Note: be careful not to get any water in the ungrouted joints.

E. Remove the epoxy residue and water by using a "towel drag" method. Hold the towel by two corners and drag it diagonally across the grout joints. Rinse the towel often and keeping changing water in the buckets to avoid residue buildup.

F. Within 15 to 20 minutes - for best results - perform a second wash with clean water, a clean while scrub pad and a neutral-pH liquid soap solution. This will help loosen any residue left on the tile from the first wash.

G. Remove the soap, epoxy residue and water by again using a "towel drag" method. Do not allow excess water to remain on the tile surface. This will allow a film to form on the surface that will be difficult to remove once hardened.

H. Check the installation the same day before leaving the jobsite to make sure it is completely clean. If the tile surface has any shiny or tacky residue, remove it with a neutral solution of liquid detergent and water.

I. Because propane gas heaters will yellow epoxy, refrain from using such heaters or properly vent all exhaust.

J. Do not step on freshly cleaned tiles. Permanent damage to the grout could result.

K. Clean tile after grouting and protect from other trades.

3.10 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

B. Keep free from heavy traffic for at least 12 hours after grouting.

C. Cure all porcelain tile floors for a minimum of 72 hours.

D. Keep steam cleaning wands 6" to 12" (15 to 30 cm) above tile surface.

E. Apply porcelain tile sealer over entire porcelain tile floor area in strict conformance with sealer manufacturer’s written instructions.

3.11 MAINTENANCE

A. Grout products are produced to the highest quality of standards. To maintain a clean tile surface, use a neutral-pH cleaner for maintaining the floor, followed by a clean-water rinse.

B. Do not use harsh chemicals to maintain the tile surface. Before proceeding with cleaning, consult the cleaner's manufacturer for compatibility, use and application instructions. Remove or rinse fatty acid residue from the grout surface to avoid potential grout deterioration cause by prolonged exposure.

END OF SECTION 093000

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 SUMMARY

A. This Section specifies the construction of all acoustical treatment and related items including installation of acoustical tiles, runners, cross tees, hangers, and appurtenances.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all acoustical treatment work, as indicated on the Drawings or as specified herein. This work shall include but not be limited to design and procurement of acoustical tile system components and associated, reinforcing, support of other work, cutting, fitting, and cleaning.

C. Consult with Owner Representative as to layout and pattern.

D. Coordinate work with mechanical and electrical trades to incorporate ceiling light fixtures and air outlets into the ceiling layout.

E. Protect finished work installed by other trades prior to acoustical treatment.

F. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.

G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

H. CISCA (AC) - Acoustical Ceilings: Use and Practice; 1999.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.
   1. Seismic Standard: Comply with the following:
      a. Verify requirements of authorities having jurisdiction as to which of the five subparagraphs below to reference, if any.
      b. ASTM E580/E580M.
      c. CISCA (AC)’s “Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings-Seismic Zones 0-2."
      d. CISCA (AC)’s “Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies-Seismic Zones 3 & 4."

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. Seismic Rx Suspension System is to be provided per manufacturers requirements to meet municipality seismic design/performance requirements.
   1. Reference additional seismic requirements as indicated on the Drawings.

1.06 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics in Accordance with ASTM E 84 for Class A finish:
   1. Flame Spread: Less than 25.
   2. Smoke Density: Less than 50.

B. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE 7.

C. Food Serving and Preparation Areas where Scheduled:
   1. United States Department of Agriculture (USDA): Approved for incidental food contact.

D. Conform to Underwriters Laboratories (UL) Fire Resistance Rating Design Number for roof/ceiling assembly indicated on Drawings.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

1.09 PROJECT CONDITIONS

A. Installation of acoustical material shall not be made when the building is excessively cold and damp, or hot and dry.

1.10 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. All tile units shall conform to FS SS-S-118, Type III, Class 25 carrying UL label.

B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type A.
      a. Pattern: 769 Cortega Square Lay-in, Medium Texture.
   2. Size: 24 by 24 inches or 24 by 48 inches.
   3. Thickness: 5/8 inch.

4. Light Reflectance: 0.80 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.55, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 40, determined in accordance with ASTM E1264.
7. Fire / Flame: Class A.
8. Panel Edge: Square.
9. Color: White.
10. Suspension System: Exposed grid.
11. Products:
    a. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle, Lancaster, PA (800) 448-1405.
    b. Substitutions: Not permitted.

C. Acoustical Panels: Painted mineral fiber, with the following characteristics:
1. Application(s): USDA approved, washable units.
2. Classification: ASTM E1264 Type A.
    a. Pattern: "E" - lightly textured.
3. Size: 24 by 24 inches or 24 by 48 inches.
4. Thickness: 5/16 inch.
5. Light Reflectance: LR1 - 75 percent, determined in accordance with ASTM E1264.
6. Panel Edge: Square.
7. Surface: 2 mil., white, stipple-textured vinyl laminate.
8. Color: White.
9. Products:
    a. National Gypsum Company, Gold Bond Gridstone Hi-Strength; www.goldbondbuilding.com
    b. Substitutions: Not permitted.

D. Acoustical Panels: Mineral fiber with plastic membrane-faced overlay, with the following characteristics:
1. Application(s): USDA approved, washable, fire rated units..
2. Finish: 2 mil. white, stipple-textured vinyl laminate.
3. Light Reflectance: LR1 - 75 percent, determined in accordance with ASTM E1264.
4. Color: White.
5. Products:
    a. National Gypsum Company, Gold Bond Gridstone; www.goldbondbuilding.com
    b. Substitutions: Not permitted.

2.02 SUSPENSION SYSTEMS

A. Cross tees shall be XL7340 Heavy Duty.

B. Exposed Grid Systems: Prelude XL 15/16” Exposed Tee System.

C. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold-down clips, stabilizer bars, clips, and splices as required.
1. Materials:

a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

D. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
1. Applications: Seismic.
2. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
3. Materials: Hot dipped steel per ASTM A653 baked polyester.
4. Furnished in accordance with ASTM C635.
5. Pattern: 2’-0" x 4’-0" square grid pattern where indicated on the Drawings.
6. All locking cross tees supporting other cross tees shall conform to the same classification as the main runners.
7. Main runners and cross tees shall be of cold rolled electro-galvanized steel with finish as specified.
8. Angles: Wall angle moldings shall be of cold rolled electro-galvanized steel with finish as specified.
9. Profile: Tee; 15/16 inch face width.
10. Finish: Baked enamel.
11. Color: White.
12. Products:
a. Armstrong World Industries, Inc., Seismic Rx Suspension System for Prelude XL Suspension Systems; www.armstrongceilings.com
b. Substitutions: Not permitted.
13. Reference additional seismic requirements as indicated on the Drawings.

2.03 LIGHT FIXTURE INTEGRATION

A. Lighting fixture types and locations do not require the normal grid spacing to be interrupted.

B. Light fixtures are specified in the electrical section of the specifications.

C. Provide all necessary materials, special fabrication, etc., necessary to provide proper spacing and installation of lighting fixtures.

2.04 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, “Direct Hung,” unless otherwise indicated.

B. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

C. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A641/A641M, Class I zinc coating, soft temper.
1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C635/C635M, Table 1, “Direct Hung”) will be less than yield stress of wire, but provide not less than 0.106" diameter wire.

D. Hold-Down Clips: Manufacturer's standard clips to suit application.

E. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

F. Perimeter Moldings: Same metal and finish as grid.

G. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
   1. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer’s standard moldings for edges and penetrations that fit acoustical tile edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.
   1. Do not install acoustical ceilings until building is enclosed, heating is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
   2. Schedule installation of acoustic units after interior wet work is completed.
   3. Install after major above ceiling work is complete.

C. Examine surfaces and adjacent areas where products will be installed and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.

D. Furnish and install acoustical materials and suspension systems of the types, sizes and designs as specified herein and noted.

E. Site Tolerances:
   1. Variation from Flat and Level Surface: 1/8 inch in 12 feet.

F. Temperature and humidity conditions closely approximating the interior conditions which will exist when the building is occupied shall be maintained before, during and after installation of ceiling materials.

G. Area shall be broom cleaned and uninterrupted for free movement of scaffolding.
   1. Scaffolding shall be a type that will not scar or mar floor surfaces and will not damage other construction.

H. Work not to proceed until satisfactory conditions described above preside.

3.03 INSPECTION

A. Inspect locations to receive work and verify all existing dimensions.

B. Ascertain, before proceeding with work, that all required inspections have been made.

C. Commencement of work constitutes acceptance of responsibility related to guarantee requirements.

3.04 COORDINATION - CONTRACTOR RESPONSIBILITY

A. Contractor shall be responsible for coordination and compatibility of the acoustical ceiling treatment, suspension system, and air distribution as specified in this section and indicated.

B. Coordinate work with mechanical and electrical trades to ensure proper compatibility and interfacing of their related areas of responsibility.

3.05 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions, as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Screw attach moldings to substrate with concealed fasteners at intervals not more than 16" O.C. and not more than 3" from ends, leveling with ceiling suspension system to a tolerance of 1/8" in 12'-0".
   3. Miter corners accurately and connect securely.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Install main runner’s 48” O.C., and directly suspend by not less than 12 gauge galvanized steel wire (prestretched) spaced 48” O.C. along the main runners.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
   1. Hanger wires shall not penetrate or be suspended from ductwork or roof deck.

H. Suspend ceiling hangers from building’s structural members, plumb and free from contact with insulation or other objects within ceiling plenum.

1. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices.

I. Provide additional hanger wires at applied beam ceilings as required by support for additional weight.

J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

K. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

L. Do not eccentrically load system or induce rotation of runners.

M. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

N. Interconnect main runners by locking cross tees 48” long to form 24” x 48” modules. Install proper length locking cross tees adjacent to all side of recessed light fixtures not supported by a main runner.

O. Install two proper type hold down clips per locking cross tee. Wherever ceiling access panels are indicated on the Drawings, substitute two proper type accessible hold down dips.

P. Hanger wires shall be wrapped tightly at least 3 full turns.

Q. Fully lock all grid members together including stabilizer bars and structural attachments capable of supporting required toads.

R. Trapeze around obstructions and level accurately.

S. No vertical hanger wire shall be more than 1 in 6 out of plum without a counter-splayed wire. Splay wires to be taut, not causing ceiling uplift (note: do not penetrate ducts) or roof deck.
1. Install vertical hanger wire 8” from wall to support each runner end at all terminal ends of main and cross runners. At maximum of two adjacent walls, runners may be attached for alignment purposes to wall or wall angle, but not elsewhere.

T. Hanger wire shall not be suspended from main roof deck (to avoid deck penetrations) but shall be suspended from the bottom of joists with clip ties as required.

U. All splays shall be four (4) No. 12 gauge wire, in line with main runners and cross runners at 45 deg angle maximum from horizontal plane of ceiling, connected with 2" of cross runner or stabilizer bar intersection on main.
1. Locate first splay locations within 4’-0” maximum of all walls.
2. Interior splays shall be maximum of 12’-0” sq. ft. in both directions.

V. Install wall molding wherever suspension components meet vertical surfaces.

W. Attach all fixtures positively to grid system.

X. Attach hanger wires to grid within 3" of all fixture corners at intermediate duty suspension system. Tandem fixtures may utilize common wires.

Y. Heavy duty suspension systems do not require additional hanger wire attachment to the grid.

Z. All fixtures over 20 lbs, but less than 56 lbs, require two (2) slack No. 12 gauge wires at opposite corners attached directly to the structure with approved hangers

3.06 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
1. Make field cut edges of same profile as factory edges.

3.07 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.08 CLEANING

A. Upon completion of installation of acoustical material and suspension systems, clean dirty or discolored surface of acoustical units and suspension components in accordance with manufacturer’s recommendations and leave free from defects.

B. Components that are damaged or improperly installed shall be removed and replaced without additional cost to the Owner.

END OF SECTION 095100

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SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.

B. Installation accessories.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021 (Reapproved 2025).

1.03 RELATED WORK

A. Installer must be professional, licensed, insured and acceptable to manufacturer of resilient flooring materials. Project Managers or Field Supervisors must be INSTALL (International Standards & Training Alliance) certified CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project or equivalent.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

C. Provide resilient wall base, flooring materials, adhesives, accessories and subfloor preparation products from one manufacturer to ensure color matching and compatibility.

D. Manufacturer shall be capable of providing technical training and technical field service representation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within the range recommended by Roppe of 65 degrees F (18degrees C) and 85 degrees F (29 degrees C).

D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Install resilient product s after other finishing operations, including painting, have been completed.

C. Maintain ambient temperatures within range of (± 10 degrees F) 65 degrees (18 degrees C) and 85 degrees F (29 degrees C) in the spaces to receive the resilient products during:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

D. Maintain relative humidity between 40% and 65% during installation.

E. Avoid conditions in which dew point causes condensation on the installation surface.

1.07 WARRANTY

A. Provide manufacturer’s standard limited commercial warranty to cover manufacturing defects.

PART 2 PRODUCTS

2.01 RESILIENT BASE

2.02 ACCESSORIES

A. Adhesive Products:
   1. Adhesives should be selected based on the site conditions and use of the space being installed.
   2. Excelsior WB-600 Acrylic Wall Base Adhesive by Roppe
      a. Unit Size: 30 oz. cartridge, 1 Gallon & 4 Gallon
      b. Coverage: 30 – 70 linear feet per cartridge, 180 – 340 linear feet per gallon
      c. Standard installations over porous backgrounds
      d. 100 % solids, solvent free and low VOCs
      e. Hard set adhesive adding to dimensionally stable materials
      f. Excellent sheer strength

3. Excelsior C-630 Contact Adhesive provided by Roppe
    a. Unit Size: 1 Quart
    b. Coverage: 20 – 40 Square Feet per unit / 120 – 140 Linear Feet per unit
    c. Standard installations over porous and non-porous substrates
    d. Hard set adhesive adding to dimensionally stable materials
    e. Excellent sheer strength
    f. Superior bond strength
    g. Great for environments with topical moisture

B. Items needed to complete the installation. Recommended accessory products:
1. Inside corners
2. Outside corners
3. Color-matched caulks

PART 3 EXECUTION

3.01 GENERAL CONTRACTOR RESPONSIBILITIES

A. Supply a safe, climate controlled building as detailed in Roppe Technical Data Sheets.

B. Ensure substrate/background meets the requirements of ASTM F1861, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.

C. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the wall base, so the contractor can acclimate the vinyl base materials per manufacturer’s instructions.

D. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity. Normal operating temperature and humidity conditions are between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the wall base per the manufacturer’s instructions.

E. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.

F. In areas where the walls are subject to direct sunlight through doors or windows, the doors and windows should be covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.

G. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.

H. Provide trained installers that are professional, licensed, insured and acceptable to manufacturer of resilient vinyl wall base materials.

I. Ensure installers or installation teams meet one of the following requirements:

1. Have completed INSTALL (International Standards & Training Alliance)
2. CFI (Certified Floorcovering Installers) training programs
3. Certified by INSTALL or CFI.
4. Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified, CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).

J. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

3.02 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Verification of Products: In accordance with manufacturer’s installation requirements, visually inspect material for size, style, color or visual defects prior to installing. Any material that is incorrect or visually defective shall not be installed.

3.03 PREPARATION

A. General: All work required ensuring substrate/background meets manufacturers’ guidelines are the responsibility of the general contractor.

B. Preparation: Ensure substrate/background meets the requirements of ASTM F1861 for resilient wall base and/or Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
1. Substrates/backgrounds must be free of visible water or moisture, dust, sealers, paint, residual adhesives and adhesive removers, solvents, wax, oil, grease, mold, mildew and any other extraneous coating, film, material or foreign matter.
2. Acclimate all products to be used during the installation and the installation environment prior to installation according to the manufacturers written instructions.
3. Fill cracks, holes, depressions and irregularities in the substrate/background to prevent transferring through to the surface of the resilient wall base.

3.04 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

3.05 INSTALLATION - RESILIENT BAS

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

C. Install material in accordance with manufacturer's recommendations.
   1. Select the appropriate adhesive for the application and job site conditions.
   2. Install material according to roll sequence or with like run numbers.
   3. Ensure material is rolled appropriately into the adhesive using a hand roller.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protection: Protect newly installed material from damage by other trades. Be sure all construction debris is picked up and vacuumed or removed prior to leaving the area. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection as well.

3.08 MAINTENANCE MATERIALS

A. Proper maintenance of the installation is critical to the long term performance of the flooring products being specified. Using the appropriate chemicals to maintain the product according to the environment in which it is specified is critical. Recommend maintenance products:
   1. Excelsior NC-900, All-Purpose Neutral pH Cleaner provided by Roppe.
      a. For initial maintenance
      b. For daily and routine maintenance
   2. Excelsior FR-920 Finish Remover.
      a. For removing of topically applied finishes.
      b. Highly concentrated, cuts through multiple layers of floor finish.

B. Initial Maintenance: Conduct initial maintenance per the manufacturer's recommended procedures stated in the Maintenance Documents. All documentation is available upon request or from the Roppe website. Excelsior Cleaning products are the recommended products for use. All can be found linked to the product on the Roppe website or at www.excelsiorproducts.net.

C. Regular Maintenance: Conduct maintenance on regular intervals as needed. Insufficient cleaning will reduce the wear life of the wall base and alter the aesthetic properties of the wall base. The amount of maintenance depends directly upon the amount of dirt and particulates the area is subjected to.

END OF SECTION 096500

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SECTION 096723
RESINOUS FLOORING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Resinous flooring system.

1.02 SUMMARY

A. This Section specifies the installation of a resinous flooring system for restrooms with threshold, including labor, resinous flooring materials, applicators, cleaners, primers, conditioners, sealant, and topcoat materials.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all coating work, as indicated on the Drawings, or as specified herein. This work shall include but not be limited to design and procurement of coating components and associated cleaning, priming, seating, patching, and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

B. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2023.

C. ASTM D523 - Standard Test Method for Specular Gloss; 2025.

D. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

F. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.

G. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and +30°C with a Vitreous Silica Dilatometer; 2024.

H. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.

I. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2025.

J. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

L. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 RELATED DOCUMENTS

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

1.05 SYSTEM DESCRIPTION

A. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system with decorative quartz aggregate broadcast and Epoxy broadcast and topcoats.

B. The system shall have the color and texture as specified by the Owner with a nominal thickness of 1/4 inch. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

C. Cove base (if required) to be applied where noted on plans and per manufacturers standard details unless otherwise noted

1.06 QUALITY ASSURANCE

A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials

B. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
   1. Specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance. Minimum of three years related experience.

C. No requests for substitutions shall be considered that would change the generic type of the specified System.

D. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.

E. System shall be in compliance with the Indoor Air Quality requirements of California as verified by a qualified independent testing laboratory.

F. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

G. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

H. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

I. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

J. Testing: As required be the latest industry codes and standards.

K. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

C. Deliver all packaged materials in original, unopened, undamaged containers, with identification labels intact, and bearing the name of the manufacturer and brand.
1. Labels shall give manufacturer’s name, brand, type, batch number and pre-blended color.
2. Contents by volume, for pigment and vehicle constituents.
3. Application instructions.
4. Color name and number.
5. Handling instructions and precautions.

D. Store materials off the ground under watertight cover and away from sweating walls and other damp surfaces until ready for use.

E. Store and protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture. Store moisture-sensitive materials off the ground, under cover, and in a dry location.
1. Remove any oily rags, waste, etc., from the building every night and take every precaution to avoid any danger of fire.
2. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 50 deg F minimum to 90 deg F maximum and maintain storage containers in a clean condition, free of foreign materials and residue.
3. In no case shall the amount of materials stored exceed that permitted by local ordinances, state laws, or fire underwriter regulations.
4. Such storage place shall be kept clean.

F. Additional requirements for product delivery, storage and handling are in Section 016000.

1.08 FIELD CONDITIONS

A. The minimum slab temperature must be conditioned to 60 degrees F before commencing installation, during installation, and for at least 72 hours after installation is complete. The substrate temperature must be at least 5 degrees F above the dew point during installation. All products must comply with local and state E.P.A restrictions.

B. Protect adjacent surfaces as required or directed.
   1. Any damage done shall be repaired by the applying contractor at his expense.
   2. A sufficient supply of clean drop cloths and other protective covering shall be properly distributed and maintained.

C. Do not apply coatings in direct sunlight or when relative humidity exceeds 85% or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

D. Finishing of the following listed items and materials will not be required and shall be protected.
   1. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles board and metal tees; other architectural features, such as “finish” hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.

1.09 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

C. Additional requirements for product warranties are included in Section 016000.

PART 2 – PRODUCTS

2.01 FLOORING

A. Sherwin Williams (Dur-A-Flex, Inc.) , Hybri-Flex EQ (self leveling broadcast quartz), epoxy/aliphatic urethane topcoat seamless flooring system.
   1. System Materials:
      a. Topping: Dur-A-Flex, Inc, Poly-Crete SL resin, hardener and SL aggregate.
      b. The broadcast aggregate shall be Dur-A-Flex, Inc. Q11 quartz aggregate.
      c. Broadcast: Dur-A-Flex, Inc. Dur-A-Glaze #4, epoxy based two-component resin.
      d. Grout Coats: Dur-A-Flex, Inc Dur-A-Glaze #4 Water Clear, epoxy-based, resin and Hardener.
      e. Top coat: Dur-A-Flex, Inc. Armor Top aliphatic urethane two-component resin.
         1) Color: As indicated on the Architectural Drawings.
   2. Patch materials:

a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Poly-Crete MD (up to ¼ inch).
b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Poly-Crete WR or Dur-A-Tex UM.

2.02 MANUFACTURER

A. Sherwin Williams (Dur-A-Flex), Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802.

B. Manufacturer of Approved System shall be single source and made in the USA.

C. No substitutions permitted.

2.03 PRODUCT REQUIREMENTS

A. Topping		Poly-Crete SL
	1. Precent Reactive	100%
	2. VOC	0 g/L
	3. Bond Strength to Concrete, ASTM D4541	400 psi, substrate fails
	4. Compressive Strength, ASTM C579	9,000 psi
	5. Tensile Strength, ASTM D638	2,175 psi
	6. Flexural Strength, ASTM D790	5,076 psi
	7. Impact Resistance @ 125 mils, MIL D-3134	160 inch lbs
	with no visible damage or deterioration	

B. Broadcast Coat		Dur-A-Glaze #4 Resin
	1. Percent Reactive	100%
	2. VOC	<4 g/L
	3. Water Absorption, ASTM D570	0.04%
	4. Tensile Strength, ASTM D638	4000 psi
	5. Coefficient of thermal expansion, ASTM D696	2 x 10-5 in/in/F
	6. Flammability ASTM D635	Self-Extinguishing
	7. Flame Spread / NFPA 101 / ASTM E84	Class A

C. Grout Coat		Dur-A-Glaze # 4 Water Clear Resin
	1. Percent Reactive	100%
	2. VOC	<4 g/L
	3. Water Absorbtion, ASTM D570	0.04%
	4. Tensile Strength, ASTM D638	4000 psi
	5. Coefficient of thermal expansion, ASTM D696	2 x 10-5 in/in/F
	6. Flammability ASTM D635 D635	Self-Extinguishing

	7. Flame Spread NFPA 101 ASTM E84		Class A
D. Topcoat			Armor Top
	1. VOC		0 g/L
	2. 60 Degree Gloss, ASTM D523		75 +/-5
	3. Mixed Viscosity, (Brookfield 25oC)		500 cps
	4. Tensile Strength, ASTM D638		7,000 psi
	5. Abrasion Resistance, ASTM D4060	Gloss	Satin
	CS 17 wheel (1,000 g load) 1,000 cycles	4	8 mg loss with grit
		10	12 mg loss without grit
	6. Pot life @ 70o F 50% RH		2 hours
	7. Full Chemical resistance		7 days

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
   1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.02 PREPARATION

A. General
   1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products
   2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
      a. Perform relative humidity test using is situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
      b. If the vapor drive exceeds 99% relative humidity or 20 lbs/1,000 sf/24 hrs then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.
   3. Mechanical surface preparation
      a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
      b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.

c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.

d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.

4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

B. Floor System Thickness Verification:

1. The Contractor shall visit the jobsite prior to the installation of the System to evaluate substrate condition, including substrate moisture transmission, quantity and severity of cracking, and the extent of repairs needed. Substrate imperfections should be repaired only after mechanical preparation of the substrate. Surface preparation reveals most imperfections requiring repair. Concrete substrates shall be tested to verify that the moisture vapor transmission of the substrate does not exceed the System manufacturers' recommendations. Cost associated with repair, leveling and remediation of the substrate are the responsibility of the provider of the substrate.

2. The Contractor should exercise care during surface preparation and system installation to protect surrounding substrates and surfaces, as well as in-place equipment. The contractor shall prepare the substrate to remove laitance and open the surface. This shall be achieved by tight brush grit blasting. Surface profile achieved shall meet Concrete Surface Profile (CSP) 3 - 5 and be free from bond-inhibiting contaminants. Costs incurred that are associated with damage from negligence or inadequate protection shall be the sole responsibility of the Contractor.

C. Sub floor tolerances are specified in Section 033000 - Cast-In-Place Concrete (in accordance with ACI PRC-302.1). Each drain in the installation area must be working and have a finished elevation equal to that of the substrate. Contractor to provide 3/4" wide by 1/4" deep keyway around floor drains and at floor termination points if not abutting an adjacent floor finish. This is to maintain thickness integrity of the flooring system. NO FEATHERING WILL BE ALLOWED.

D. The finished flooring System must be protected by the General Contractor or, as a separate bid item, by the installing contractor until it is inspected and turned over to the Owner.

E. The minimum slab temperature must be conditioned to 60 deg F before commencing installation, during installation, and for at least 72 hours after installation is complete.

F. Maintain lighting at a minimum uniform level of 50 or more foot candles in areas where the flooring System is being installed. It is the recommendation of the manufacturer that the permanent lighting be in place and working during the installation.

G. Leaks from pipes and other sources must be corrected prior to the installation of the flooring system.

H. Examine all surfaces to receive Epoxy and report any conditions detrimental to the finished product. Prepare surfaces in accordance with manufacturer's printed recommendations.

I. Apply each component of the System in compliance with manufacturer's written installation instructions and strictly adhere to mixing and installation methods, recoat windows, cure times and environmental restrictions. The System is to be installed directly over non-moving control joints and cracks which have been treated with crack suppression membrane with fiberglass scrim as manufactured by "The Sherwin Williams Company." Resinous Flooring System will terminate at the edge of isolation and expansion joints as designated by the Architect, Engineer or Design Professional. Integral cove base shall be installed where specified in the drawings.

J. After preparation, evaluation of quantity and severity of cracks in concrete will determine the needed repairs.

K. All expansion joints must be honored through the flooring system.

L. Mix ingredients in accordance with manufacturer's printed directions using manufacturer approved equipment.

M. Any repairs in the Resinous Flooring System will need to be approved and coordinated by the Owner's representative.

3.03 WORKMANSHIP

A. Perform all work using only experienced, competent painters in accordance with the best standards of practice in the trade.

B. When completed, the coating shall represent a first-class workmanlike appearance.

C. Apply all materials under adequate illumination.

3.04 APPLICATION

A. General
   1. The system shall be applied in five distinct steps as listed below:
      a. Substrate preparation.
      b. Topping/overlay application with quartz aggregate broadcast.
      c. Resin application with quartz aggregate broadcast.
      d. Grout coat application
      e. Topcoat application.
   2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
   3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
   4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
   5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.
   6. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. Topping
   1. The topping shall be applied as a self-leveling system as specified by the Architect. The topping shall be applied in one lift with a nominal thickness of 1/8 inch.
   2. The topping shall be comprised of three components, a resin, hardener and aggregate as supplied by the Manufacturer.
   3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
   4. The topping shall be applied over horizontal surfaces using ½ inch "v" notched squeegee, trowels or other systems approved by the Manufacturer.
   5. Immediately upon placing, the topping shall be degassed with a loop roller.
   6. Q11 Quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.8 lbs/sf.
   7. Allow material to fully cure. Sweep and vacuum to remove all loose aggregate.

C. Broadcast
   1. The broadcast coat resin shall be applied at the rate of 50 sf/gal.
   2. The broadcast coat shall be comprised of liquid components, combined at a ratio of 2 parts resin to 1 part hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
   3. Q11 Quartz aggregate shall be broadcast into the wet resin at the rate of 0.5 lbs/sf.
   4. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

D. Topcoat
   1. The topcoat shall be roller applier with a coverage rate of 500 sf/gal.
   2. The finished floor system will have a nominal thickness of 1/4 inch.

E. FIELD QUALITY CONTROL
   1. Tests, Inspection
      a. The following tests shall be conducted by the Applicator:
         1) Temperature
            a) Air, substrate temperatures and, if applicable, dew point.
         2) Coverage Rates
            a) Rates for all layers shall be monitored by checking quantity of material used against the area covered.

F. CLEANING AND PROTECTION
   1. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
      a. After completing coating work, clean glass and spattered surfaces. Remove spattered coatings by washing, scraping, or other methods, being careful not to scratch or damage adjacent finished surfaces.
      b. Observe all fire and health precautions when handling or storing solvents.
   2. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
   3. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

G. PROTECTION
1. Prohibit traffic on floor finish for 48 hours after installation.
2. Barricade area to protect flooring until fully cured.
3. Protect work of other trades from damage whether being coated or not. Correct damage by cleaning, repairing, replacing, and recoating as approved by Architect. Leave in an undamaged condition.
4. Provide ‘‘Wet Paint’’ signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.
    a. After construction activities of other trades are complete, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 096723

SECTION 097200
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiber Reinforced Panel (FRP) Wall covering.

1.02 SUMMARY

A. This Section specifies the construction of all prefinished fiberglass reinforced polyester (FRP) panel systems for adhesive mounting, accessories and related items including installation of panels, trim, adhesive, and sealant.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all FRP panels and related items, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work may include but not be limited to design and fabrication of FRP panels and associated cutting, fitting, gluing, caulking, reinforcing, support of other work, insulating, and cleaning.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ASTM C1467/C1467M - Standard Specification for Installation of Molded Glass Fiber Reinforced Gypsum Parts; Current Edition.

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

C. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.

D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

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

C. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

D. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

E. Manufacturer's instructions for installation shall be delivered and stored with the materials.

F. Testing: As required be the latest industry codes and standards.

G. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

D. Store materials off the ground under watertight cover and away from sweating walls and other damp surfaces until ready for use.

E. Environmental Conditions:
   1. Comply with requirements in ASTM C1467/C1467M.
   2. Do not deliver or install FRP fabrications until building is enclosed, wet work is complete, and HVAC system is operating and continuously maintaining temperature and relative humidity at levels intended for building occupants.

F. Conditioning: Acclimate FRP fabrications to ambient temperature and humidity of spaces in which they will be installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

G. Field Measurements: Where FRP fabrications 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.

H. Additional requirements for product delivery, storage and handling are in Section 016000.

1.06 FIELD CONDITIONS

A. All work herein requires coordination with trades whose work connects with, is affected or concealed by drywall.
   1. Before proceeding with the work, make certain all required inspections have been made.
   2. All work shall be coordinated with other sections.

B. Inspect surfaces to receive the prefinished panels before starting work and do not start until surfaces are acceptable.
   1. Starting work under this Section implies acceptance of surfaces.

C. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

D. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

1.07 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 Wall Coverings

A. General Requirements:
1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

B. Wall Covering: Fiberglass reinforced polyester (FRP) water resistant, non-fire-rated, high strength panels and accessories shall be as manufactured by the following manufacturers.
1. Thickness: 3/32" nominal thickness FRP flat panels.
2. Color: As indicated on the Drawings.
3. Style / Pattern: As indicated on the Drawings.
4. Surface Texture: As indicated on the Drawings.
5. Water Absorbtion: 0.17 % when tested in accordance with ASTM D570.
6. Manufacturers:
   a. Crane Composites, Inc. (formerly Kemlite) 23525 West Eames Street, Channahon, Illinois 60410. Toll Free 800-435-0080. Phone 815-467-8600. Fax 815-467-8666. Website www.cranecomposites.com. Email salesbp@cranecomposites.com
   b. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com .
   c. Substitutions: See Section 016000 - Product Requirements.

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

D. Vinyl (PVC) molding shall be one piece caps (top, bottom and edges), division bars, inside and outside corners as required to provide a finished appearance and a moisture-proof installation.
1. Match FRP panel color.

E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

F. Sealant shall be gunnable, silicone, rubber-based construction grade as recommended by panel manufacturer. Color as required by Architect.

G. Fabricate FRP units to comply with ASTM D5319. Repair hollows, and voids. Replace all FRP units that have scratches, or other surface imperfections. Fabricate units in lengths and sizes that will minimize the number of joints between abutting units.

H. Trim: Extruded PVC of same color to match panels.
1. Outside corners, inside corners, edge trim, base molding, borders and division molding.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If backing materials are out of alignment, bowed, or warped, correct them to make true surfaces before application of FRP and acrylic panels.
1. Use method of correction approved by the Architect.
2. Finished walls shall be made straight, plumb and level without ridges, bows, or warps.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Vacuum clean surfaces free of loose particles.

F. Take panels out of cartons and allow to acclimate to room conditions for at least 48 hours prior to installation.

G. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface, free of flaking, unsound coatings, cracks, and defects, using the methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.
1. Metals: If not factory primed, clean and apply metal primer.
2. Gypsum Board: Prime with primer recommended by wall-covering manufacturer.

3. Check painted surfaces for pigment bleeding. Sand gloss, semi-gloss, and eggshell finish with fine sandpaper.

H. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

I. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer.

J. Clean surfaces thoroughly prior to installation.

K. Protect existing surfaces from damage due to installation.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

C. Apply FRP panels with the long dimension vertically from floor to ceiling.
1. Install panels with no gaps or overlaps, no lifted or curling edges and no visible shrinkage.
2. Install with adhesive in accordance with manufacturers recommendations.
3. Fully bond wall panels to substrate. Adhere panels at 16” O.C. maximum.
4. Remove air bubbles, wrinkles, blisters, and other defects.
5. Install continuous bead of silicone sealant in each joint, trim groove, and between trim and adjacent construction, maintaining 1/8" expansion space.
6. Cut and fit neatly around all outlets and switches.
7. Caulk all seams, curb junctures, penetrations, and corners before installing panels and bed inside corner trim in a bead of sealant.
8. Panel installer is responsible for all caulking.
9. Avoid contamination of panel faces with adhesives, solvents, or cleaners.
    a. Clean as necessary and replace materials if not possible to repair to original condition.
10. Do not use button fasteners.

D. Erection techniques shall result in plumb, true, and straight surfaces without waves or buckles, free of unevenness at joints, and aligned with adjacent materials. Use concealed shims where required for alignment.

E. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Cleanup shall be in accordance with the manufacturer’s recommendations, and as directed by Architect.

B. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

C. Reinstall wall plates and accessories removed prior to work of this section.

3.05 DEFECTIVE WORK

A. Touchup, repair or replace damaged products after Substantial Completion.

B. All work deemed defective by the Architect shall be corrected as direct by the Architect, at no additional cost to the Owner.

C. The following partial list constitutes possible defective work items:
   1. Non-adhered panels.
   2. Improperly installed trim.
   3. Out of plumb and uneven surfaces.
   4. Hollows and voids.

D. Replace panels that have scratches and other surface imperfections.

3.06 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION 097200

SECTION 099000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Interior painting and coating systems.

C. Exterior painting and coating systems.

1.02 SUMMARY

A. This Section specifies the work necessary to complete all surface preparation, painting, and finishing required for interior and exterior surfaces including paint, varnish, stain, primers, tint, drop cloths, rags, fillers cleaners, applicators, and finishing materials.

B. Contractor shall be responsible for the finish of all buildings and site components, and provide all labor, materials, equipment, and services necessary to furnish, transport, and install all painting and finishing work, as indicated on the Drawings or as specified herein. This work shall include but not be limited to painting, finishing, and associated inspecting, cleaning, sanding, varnishing, priming, filling, and testing.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

C. SSPC-SP 2 - Hand Tool Cleaning; 2024.

D. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.05 CLOSEOUT SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to manufacturer's label.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.
   1. Specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
   2. Elastomeric coating is not for use on overhead horizontal surfaces (undersides of balconies, soffits, etc.).
   3. Elastomeric coating is not for use below grade. Will not withstand hydrostatic pressure.
   4. Elastomeric coating not for use on horizontal surfaces (floors, roofs, decks, etc.) where water will collect.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Certification: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Contractor is to ensure that all products used are completely compatible.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: As required by the latest industry codes and standards.

G. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Transport and handle all materials in such a manner as to prevent damage. Dumping on the ground is not permitted. Locate stacks, or bins to avoid or protect material from heavy and unnecessary traffic.

C. Store and protect materials from exposure to harmful weather conditions, and at temperature and humidity conditions recommended by manufacturer. Some materials may need to be stored in protected enclosures and handled by methods which avoid exposure to moisture. Store moisture-sensitive materials off the ground, under cover, and in a dry location.
   1. Remove any oily rags, waste, etc., from the building and project site every night and take every precaution to avoid any danger of fire.

2. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F and maintain storage containers in a clean condition, free of foreign materials and residue.
3. In no case shall amount of materials stored exceed that permitted by local ordinances, state laws, or fire underwriter regulations.
4. Such storage place shall be kept clean and free of foreign materials and residue.
5. Correct all damage to surroundings in a timely manner.
6. All products must comply with local and state E.P.A. restrictions.

D. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.

E. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

F. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.08 FIELD CONDITIONS

A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.

B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

1.09 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.

B. Comparable Products: Products of approved manufacturers will be considered in accordance with 016000 - Product Requirements, and the following:
1. Products that meet or exceed performance and physical characteristics of basis of design products.
2. Other Acceptable Manufacturers:
   a. PPG; www.ppgpmc.com.
   b. No substitutions are permitted..

C. Refer to Part 4 of this specification for Instructions for Contractor.
   1. As part of the list of proposed subcontractors, the painting subcontractor shall indicate the name of the manufacturer whose materials he purposes to use.

2.02 PAINTINGS AND COATINGS

A. General:
   1. All paint materials shall be factory fresh.
   2. Provide factory-mixed coatings unless otherwise indicated.
   3. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
   4. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.

B. Brands of paint, varnish, and stains are specified herein.

C. Basic painting materials such as linseed oil, shellac, turpentine, thinners, driers, etc., shall be highest quality, made by manufacturer as specified, having identifying labels on containers.

D. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply, exclusive of colorants added to a tint base, with the most stringent requirements specified in the following: (These requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop.)
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
      c. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
      d. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
      e. Shellacs, Clear: VOC not more that 730 g/L.
      f. Shellacs, Pigmented: VOC not more than 550 g/L.
      g. Floor Coatings: VOC not more than 100 g/L.
      h. Flat Topcoat Paints: VOC content of not more than 50 g/L.
      i. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
      j. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
      k. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
      l. Dry-Fog Coatings: VOC content of not more than 400 g/L.
      m. Synthetic Interior Clear Sealers: VOC content of not more than 750 g/L
      n. Opaque Wood Stain: VOC content of not more than 100 g/L

E. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 Paint Systems - Exterior

A. Concrete: Cementitious siding, Flexboard, Transite, non-roof shingles, common brick, EIFS / cement-plastering (stucco), tilt-up, precast, and poured-in-place cement.
   1. Latex Systems:
      a. Flat Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer LX02W50: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams A-100 Exterior Latex Flat, A6 Series: www.sherwin-williams.com/#sle.
         3) 1st Coat: PPG Perma-Crete Interior / Exterior Alkali Resistant Primer Series 4-603
         4) 2nd and 3rd Coat: PPG Speedhide Exterior 100% Acrylic Latex Series 6-610XI
   2. Elastomeric System: Exterior Masonry Surfaces (Not including cementitious siding, Flexboard, Transite board or non-roof shingles.)
      a. Previously Coated: After power washing, apply 1 coat of Perma-Crete Masonry Surface Sealer Series 4-809 to tie any chalk to the surfaces or S-W Loxon Acrylic Conditioner, LX03W0100.
      b. Flat Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer LX02W50: www.sherwin-williams.com/#sle.
            a) 5.3 to 8 mils wet, 2.1 to 3.2 mils dry.
         2) 2nd and 3rd Coat: Sherwin-Williams ConFlex XL Elastomeric High Build Coating, CF11W51: www.sherwin-williams.com/#sle.
         3) 1st Coat: PPG Perma-Crete Block and Masonry Surfacer / filler Series 4-100XI
            a) 5.3 to 8 mils wet, 2.1 to 3.2 mils dry.
         4) 2nd and 3rd Coat: PPG Perma-Crete Pitt-flex Elastomeric Coating Series 4-110XI
            a) 13 to 16 mils wet, 6 to 7.5 mils dry per coat.
            b) (A minimum total dry film thickness of 12-15 mils of topcoat and a surface with 10 or less pinholes per square foot is required for a waterproofing system)

B. Metal: Aluminum, galvanized.
   1. Latex Systems:
      a. Gloss Finish:
         1) 1st Coat: Sherwin Willliams Pro Industrial Pro-Cryl, B66-310
         2) 2nd and 3rd Coats: Sherwin-Williams Pro Industrial Acrylic Gloss, B66-600 Series: www.sherwin-williams.com/#sle.
         3) 1st Coat: PPG Pitt-Tech Plus 4020PF Series
         4) 2nd and 3rd Coats: PPG Pitt-Tech Plus EP Gloss Series (Low VOC), 90-1510.

C. Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
   1. Latex Systems:

a. Semi-Gloss Finish:
1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
3) 1st Coat: PPG Pitt-Tech Plus 4020PF Series
4) 2nd and 3rd Coat: PPG Pitt-Tech Plus EP Semi-Gloss Series, 90-1610.

2.04 Paint Systems - INTERIOR

A. Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
1. Latex Systems:
a. Flat Finish:
1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer, LX02W50 Series: www.sherwin-williams.com/#sle.
2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Flat, B30-2600 Series: www.sherwin-williams.com/#sle.
3) 1st Coat: PPG Perma-Crete Block & Masonry Surfacer/ Filler, 4-100XI.
4) 2nd /3rd Coats: PPG Speedhide ZERO VOC, 6-5110

B. Masonry CMU: Concrete, split face, scored, smooth, high density, low density, and fluted.
1. Latex Systems:
a. Semi-Gloss Finish High Performance (HP):
1) 1st Coat: Sherwin-Williams PrepRite Block Filler, B25W25: www.sherwin-williams.com/#sle.
2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series: www.sherwin-williams.com/#sle.
3) 1st Coat: PPG Speedhide Interior/Exterior Hi-Fill Block filler, 6-15XI.
4) 2nd / 3rd Coats: PPG Speedhide ZERO Interior S/G, 6-5510.

C. Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
1. Latex Systems:
a. Eg-Shel/Satin Finish High Performance:
1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
2) 2nd and 3rd Coats: Sherwin-Williams Pro Industrial Acrylic Eg-Shel, B60-660 Series: www.sherwin-williams.com/#sle.
3) 1st Coat: PPG 7-Line RUST INHIBITIVE Steel Primer, 7-852.
4) 2nd and 3rd Coats: PPG Pitt-Tech Plus EP Satin 90-1710 Series.
2. Dryfall Waterborne Topcoat:
a. Eg-Shel Finish:
1) 1st Coat: (When over steel) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
2) 1st Coat: (When over wood) Sherwin Williams ProBlock Latex Primer/Sealer, B51-620

3) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall, B42-82 Series: www.sherwin-williams.com/#sle.
4) 1st Coat: (When over steel) PPG Pitt-Tech Primer 90-712 Series
5) 1st Coat: (When over wood) 1 coat PPG Seal Grip Universal Primer Series 17-921XI.
6) 2nd and 3rd Coat: PPG Speedhide Super Tech WB Interior DRY FOG Eggshell, 6-724XI.

D. Drywall: Walls, ceilings, gypsum board, and similar items.
1. Latex Systems:
a. Eg-Shel Finish:
1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Eg-Shel, B20-12650 Series: www.sherwin-williams.com/#sle.
3) 1st Coat: PPG Speedhide 0VOC Latex Primer Series 6-4900XI
4) 2nd and 3rd Coat: PPG PPG Speedhide ZERO VOC, 6-5310.

E. Concrete: Floors, non-vehicular, in “No Minor” Zones: Provide the following finish system over interior concrete surfaces:
1. Epoxy Finish: One finish coat over properly prepared concrete.
a. Topcoat: PPG Paints. Amerlock 600, High -Build Semi-Gloss Epoxy Coating. Applied Dry Film Thickness: 5.0 mils min. or Sherwin Williams MacroPoxy 646-100, B58-620 (7.0-13.5 mils wet, 5.0-10.0 mils dry).
b. For non-slip applications. Add appropriate amount of Zinsser brand Skid Tex non-skid additive per manufacturer’s instructions or S-W Shark Grip Additive.

F. Interior Wood (sealed):
1. 2 coats PPG / Deft Interior Water Based Polyurethane Series DFT158 or S-W Minwax Water-Based Oil Modified Polyurethane Semi-Gloss

2.05 MATERIALS NOT SPECIFIED

A. Painting Subcontractor shall designate type of paint to be used on each portion of the work not itemized above. .

B. All graphic lines to be applied using “easy-mask” masking tape.

C. All cut lines to be true without overlaps or voids.

D. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 WORKMANSHIP

A. Perform all work using only experienced, competent painters in accordance with the best standards of practice in the trade.
   1. Hand brush, spray with back-rolling, or roll work except where otherwise permitted or directed.
   2. When completed, the coating shall represent a first-class workmanlike appearance.
   3. Apply all materials under adequate illumination and with adequate ventilation.

B. Tint all primers and undercoats to approximately the color of the finish coat with each coat being sufficiently different from the work in place to permit easy identification.

C. Prime coats specified herein will not be required on items delivered with prime or shop coats already applied, unless otherwise specified.

D. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with a prime coat and one finish coat minimum.

E. If undercoats or other conditions show through the topcoat, apply additional coats until cured film has a uniform paint finish, color and appearance.

F. 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.

G. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

H. If, after treatment, the completed finish (or any portion thereof) blisters, checks, peels, or otherwise shows indication of dampness or other irregular condition of surface, the painting contractor shall, at his own expense, remove the applied treatment and refinish the part affected to the satisfaction of the Owner or Architect.

I. All exposed water, gas, waste piping, exposed conduits, lighting panels, telephone terminal boxes and galvanized or insulated ducts, shall be painted in all sales areas and other areas openly visible by sales floor, unless otherwise scheduled.

J. Grilles and registers shall be spray painted with enamel or lacquer to match walls and ceilings.
   1. Paint materials shall not sag, run, or bind movable parts of grilles or registers.

K. Duct throats behind all grilles, registers, louvers, baffles, etc., shall be given one coat of flat black oil paint, wherever visibility of the interior of the ducts is allowed.

L. Paint exposed gas lines on roof with extra paint on threaded areas. Remove all rust, chipped and pealing paint prior to final paint application.

M. Carefully examine the Mechanical Drawings, Electrical Drawings, and Specifications, to determine the amount of exposed work to be painted.

3.03 PREPARATION

A. Inspection of surfaces: Do not begin painting on any surface until it has been inspected and is in proper condition to receive the paint as specified.
   1. Should any surface be found unsuitable to produce a proper paint finish, notify the General Contractor in writing.
   2. Prior to painting, the painting contractor should determine dryness of all moisture-holding materials by use of a reliable electronic moisture meter.
      a. Interior Finishes:
         1) Concrete: 12%
         2) Wood: 15%
         3) Gypsum Board: 12%
         4) Plaster: 12%
   3. Prior to sealing, the painting contractor should determine dryness of all moisture-holding materials by use of a reliable electronic moisture meter.
      a. Interior Finishes:
         1) Wood: 6 - 8%
   4. Apply no material until the unsuitable surfaces have been made satisfactory.
   5. After acceptance of surface, by application of first coat of paint, assume responsibility to rectify any unsatisfactory finish results.

B. Clean surfaces thoroughly and correct defects prior to application.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   1. Provide barrier coats over incompatible primers or remove and reprime.

D. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.

E. Stir material before application to produce a mixture of uniform density.
   1. Stir as required during application.
   2. Do not stir surface film into material.
      a. If necessary, remove surface film and strain material before using.
      b. Tint all primers and undercoats to approximately the color of the finish coat with each coat being sufficiently different from the work in place to permit easy identification.

F. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.

G. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk.
   2. Fill bug holes, air pockets, and other voids with cement patching compound.
   3. Prepare concrete in accordance with SSPC-SP 13/NACE No.6.

H. Masonry: Remove efflorescence and chalk.

I. Cementitious Siding: Remove dirt, dust and other foreign matter. Pressure clean, if needed, to remove grease, oil, and loose particles.

J. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.

K. EIFS or Stucco Surfaces: (Where indicated on the Drawings)
   1. Fill cracks; holes or imperfections in plaster with patching plaster and smooth off to match adjoining surfaces.
   2. Before painting, surfaces shall be first tested for dryness with moisture testing device.
   3. Do not apply paint or sealer on plaster when the moisture content exceeds 12%, as determined by the testing device.
      a. Test sufficient areas in each space and as often as necessary to determine the proper moisture content for painting.
      b. If the moisture content is between 8% and 12%, prime with alkali resistance primer.
      c. If 8% or less, prime with specified primer.
   4. Remove the dry sand deposit from all plaster surfaces by brushing with stiff brush before painting.
   5. Test pH of surface prior to painting.
      a. If pH level is not in compliance with paint manufacturer’s requirement, the entire surface is be primed in accordance with manufacturer’s recommendations.

L. Concrete Floors and Traffic Surfaces: Prepare concrete in accordance with SSPC-SP 13/NACE No.6.

M. Aluminum: Remove surface contamination and oil; wash with solvent according to SSPC-SP 1.

N. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

O. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.
   3. Where steel or iron have a heavy coating of scale, remove descaling, or wire brush as necessary, to produce a satisfactory surface for painting.
   4. When area will be exposed to view, use sandpaper over the entire treated area to provide a smooth surface.
   5. Feather the edges of surrounding undamaged prime coat, and spot prime in a manner to eliminate evidence of repair.

P. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.
   1. Use sandpaper to smooth and even each surface, and then dust off.
   2. After primer or stain coat has been applied, thoroughly fill all nail holes and other surface imperfections with putty tinted with primer or stain to match wood color.
   3. Sand all woodwork between coats to provide a smooth surface.
   4. Cover knots and sap streaks with a thin coat of shellac, unless noted otherwise.

3.04 PREPARATION - EXTERIOR MASONRY FOR ELASTOMERIC COATINGS

A. General: Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
   1. Remove all surface contamination by washing either TSP, ProClean Professional Prepwash Cleaner, or other manufacturer-approved cleaner, rinse thoroughly and allow to dry.
   2. Existing peeled or checked paint should be scraped and sanded to a sound surface.
   3. Glossy surfaces should be sanded dull.
   4. Stains from water, smoke, ink, pencil, grease, etc., should be sealed with SealGrip Primer Series 17-921 or S-W ProBlock Interior Exterior Latex Primer, B51W00620 or other manufacturer-approved product.
   5. After completing coating operations, reinstall items removed, using workers skilled in trades involved.

B. Masonry surfaces must be dry, 15% or less of water, and within a pH range of 6 to 12.
   1. If the pH is above 12, prime the surface first with Perma-Crete Alkali Resistant Primer Series 4-603.

C. Sealing and Patching:
   1. After cleaning the surface thoroughly, prime any bare surface with Perma-Crete Alkali Resistant Primer Series 4-603 (or S-W Loxon Concrete & Masonry Primer/Sealer, LX02W0050), apply Perma-Crete Series 4-1000, allow to dry, then topcoat (or S-W Concrete & Masonry Elastomeric, A05W00500.)

D. To improve the performance in selected areas:
   1. Use caution when preparing the substrate to create a uniform surface.
   2. Cracks, crevices, and through-wall openings must be patched using Perma-Crete Series 4-1000 or S-W Concrete & Masonry Elastomeric, A05W00500.
   3. Fill voids and openings around windows and doors using Perma-Crete Series 4-1000 (or S-W Concrete & Masonry Elastomeric, A05W00500).
   4. Stripe coat all inside and outside corners and edges with 1 coat of Perma-Crete High Build Topcoat Series 4-22XI (or S-W Conflex Acrylic Coating, CF13W0051).

E. To repair openings and cracks:
   1. No greater than 1/32” wide:
      a. Apply one (1) coat of Perma-Crete High Build Topcoat Series 4-22XI or S-W Conflex Acrylic Coating, CF13W0051.

2. From 1/32” up to 1/16” wide:
    a. Bridge over voids and small cracks up to 1/16” wide using Perma-Crete Series 4-1000 or S-W Concrete & Masonry Elastomeric, A05W00500.
    b. The product must be feathered to zero at the edges using a brush, knife, or trowel, to prevent the repaired area from telegraphing through the subsequent finishes.
    c. Do not apply more than 1/4” in depth in one application.
3. From 1/16” to 3/8” wide:
    a. Cracks and voids between 1/16” and 3/8” wide should be opened to a sound surface.
    b. Flush out the opening to remove all dust.
    c. If dust is still evident, seal the surface with Perma-Crete Masonry Surface Sealer Series 4-809 to bind the dust to the surface or S-W Loxon Acrylic Conditioner, LX03W0100.
    d. Fill the opening with Perma-Crete Series 4-1000, provide a small crest over the opening to allow for shrinkage or S-W Concrete & Masonry Elastomeric, A05W00500.
    e. The product must be feathered to zero at the edges using a brush, knife, or trowel, to prevent the repaired area from telegraphing through the subsequent finishes.
    f. Do not apply more than 1/4” depth in one application.
    g. Allow this to cure 24 hours.
4. The depth of opening should be half the width of the joint, with a maximum depth of 1/2".
    a. In deep openings, the depth of the sealant should be controlled with a closed call, “non-gassing” type backer rod.
    b. The backer rod should be about 1/8” wider than the opening.
    c. Do not apply more than 1/4” depth in one application.
5. If the opening is 1/4” or greater, for maximum performance, prevent 3 point adhesion with backer rods or bond breaker tape.
    a. Three point adhesion problems occur in cracks when the sealant adheres to the walls and the bottom of a crack, and a significant amount of flexibility is lost.
    b. Two point adhesion – wall to wall in a crack – using backer rods or bond breaker tape offers the maximum flexibility and performance.

3.05 PROTECTION

A. Before painting, remove hardware, accessories, plates, lighting fixtures and similar items, or provide ample protection of such items.
    1. On completion of each space, replace above items.
    2. Protect adjacent surfaces as required or directed.
    3. Any damage done shall be repaired by the painting contractor at his expense.
    4. A sufficient supply of clean drop cloths and other protective covering shall be properly distributed and maintained.

B. Finishing of the following listed items and materials will not be required and shall be protected.
    1. Stainless steel, brass, bronze, copper, chromium, anodized aluminum; specialty finished articles such as porcelain enamel, plastic coated fabrics, and baked enamel.

2. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles, board and metal tees; other architectural features, such as “finish” hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.
3. All paint spots shall be removed from the above surfaces.

3.06 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.

D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

E. Exposed surfaces: Contractor shall paint or finish all exposed surfaces on all buildings and site components unless otherwise noted or indicated.

F. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.

G. All interior and exterior exposed metal shall be painted or have a manufactured final surface finish.

H. Provide uniform paint shades of the same color by mixing paint 1/3 from one bucket, 1/3 from second bucket, and 1/3 from the third bucket (typical) into a separate 5 gallon bucket.

I. Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting, as soon as practical after preparation and before surface deterioration is allowed to take place.

J. Stain or paint only when surfaces are clean, dry, smooth and adequately protected from dampness.

K. Each coat of paint shall be well brushed on, or sprayed and back roIled, worked out evenly, and allowed to dry at least 24 hours before the subsequent coat is applied.

L. Finished work shall be uniform, of approved color, smooth and free from runs, sags, clogging or excessive flooding.

M. Make edges of paint adjoining other materials or colors sharp and clean, without overlapping.

N. Where high gloss enamel is used, lightly sand undercoats to obtain a smooth finish coat.

O. Each coat of material applied must be inspected and approved by the Owner or Architect before the application of the succeeding specified coat; otherwise no credit for the concealed coat will be given, and the contractor shall assume the responsibility to recoat the work in question.

P. At completion, touch-up and restore finish where damaged and leave finish surfaces in good condition.

Q. Interior Gypsum Board Walls with Level 4 Finish:
1. Spray-apply prime coat with no backroll using a low-pressure spray to avoid texture of the prime coat.
2. Spray-finish coats over prime coat. If a roller is used move roller in one direction full height of the wall and use the shortest knap roller possible so as not to leave a textured finish on the wall. Do not backroll. If flashing occurs, sand wall finish smooth and repaint the area full height of wall.

R. Interior Gypsum Board Walls and Ceilings with Level 3 Finish:
1. Spray and roll apply prime coat avoiding as much texture as possible.
2. Roll-apply finish coats over prime coat. If a sprayer is used backroll with a dry roller to eliminate spray overlaps and use the shortest knap roller possible so as not to leave a textured finish on the wall. If flashing occurs, sand wall finish smooth and repaint the area full height of wall or full width of ceiling.

S. Dry Fall Ceilings:
1. Spray-apply prime coat for metals and wood as listed above.
2. Spray-apply finish coats over prime coat using 50% overlap with each pass. Cross spray at right angles to eliminate holidays and bare areas.

T. Minimum Coating Thickness:
1. Apply paint materials no thinner than manufacturer’s recommended spreading rate.
2. Provide total dry film thickness of the entire system as recommended by manufacturer.

U. Prime Coats:
1. Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others.
2. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

V. Pigmented (Opaque) Finishes:
1. Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage.
2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
3. Do not reduce, thin or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
4. Regardless of number of coats specified, apply as many coats as necessary for complete hide and uniform appearance.
5. If final painting is delayed more than 2 weeks after installation of exterior wood, apply primer within 2 weeks and final coating within 2 weeks.

W. Transparent (Clear) Finishes:
1. Use multiple coats to produce a glass-smooth surface film of even luster.

2. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

3.07 APPLICATION - ELASTOMERIC COATINGS

A. General: Apply elastomeric coatings according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Colors, surface treatments, and finishes are indicated on the Drawings.
   2. Do not paint over conditions detrimental to formation of a durable coating film, such as dirt, rust, scale, grease, moisture, and scuffed surfaces.
   3. Provide finish coats compatible with primers used.

B. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

C. Apply at temperatures between 50 deg F and 100 deg F. Do not reduce.
   1. Brush: Use a nylon/polyester brush. Avoid over-brushing which causes air bubbles.
   2. Roller: Use a 1/2” to 1-1/2” nap synthetic roller cover. Avoid rapid rolling which causes bubbling.
   3. Spray-Airless:
      a. Pressure, minimum 2300 psi.
      b. Tip, minimum 0.21".
   4. Back-roll all spray applications.
   5. The substrate and its condition will determine the application procedure.
   6. Minimize pinholes by:
      a. 2 coat application with overnight drying between coats.
      b. Spray application with back-rolling.
      c. Power rolling.

3.08 PRIMING

A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.09 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

D. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
   1. Remove spattered coatings by washing with soap and warm water, being careful not to scratch or damage adjacent finished surfaces.

E. Protect work of other trades, whether being painted or not, against damage from painting.

F. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

G. Provide “Wet Paint” signs to protect newly painted finishes.

H. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

I. Clean spills and spatters immediately with soap and warm water.
   1. After completing coating work, clean hands and tools immediately after use with soap and warm water.
   2. After cleaning, flush spray equipment with mineral spirits to prevent rusting of the equipment.
   3. Follow manufacturer’s safety recommendations when using mineral spirits.

3.10 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Protect work of other trades from damage whether being coated or not. Correct damage by cleaning, repairing, replacing, and recoating as approved by Architect. Leave in an undamaged condition.

C. Touch-up damaged finishes after Substantial Completion.

D. Provide "Wet Paint" signs to protect newly coated finishes. Remove temporary protective wrappings provided by others to protect their work after completing coating operations.
   1. After construction activities of other trades are complete, touch up and restore damaged or defaced coated surfaces. Comply with procedures specified in PDCA P1.

PART 4 - PPG CONTRACTOR JOB TRACKING FORM

PPG CONTRACTOR JOB TRACKING FORM

(To be included in Contractor Bid Package)

INSTRUCTIONS FOR CONTRACTOR:

Please complete this form with as much information as available.

If you have an assigned PPG Sales Representative or a Home store that services your account please contact them directly with this form.

If you do not have a PPG assigned account manager please email this form to Vito Anteri, Corporate Accounts Manager, Email: VFAnteri@ppg.com .

This form must be forwarded to PPG prior to the start of any Capital Expenditure Project.

A job account must be assigned for every project.

INSTRUCTIONS FOR PPG PAINTS EMPLOYEES:

Upon receiving this form please open a job account for the paint contractor.

The job account must read as follows; Sprouts/Name of City.

IA job account is strictly required for all Sprouts related projects.

Upon opening a Sprouts job account, an email containing the 12 digit job account number is to be sent to shareesch@ppg.com for tracking purposes.

All Purchases associated with said project are to be made on this job account only.

Name of Contractor: _____

PPG Account Number (Existing): _____

Sprouts Job Account number (To be assigned): _____

Name and Address of Sprouts related Project: _____

_____

Name/Store of PPG Contact: _____

Estimated Materials Needed: _____

Additional Comments/Needs of Contractor: (I.E renderings needed, drawdowns required,
Special environmental restrictions: _____

_____

PART 4 - SHERWIN WILLIAMS PAINTS CONTRACTOR JOB TRACKING FORM

SHERWIN WILLIAMS PAINTS CONTRACTOR JOB TRACKING FORM

(To be included in Contractor Bid Package)

INSTRUCTIONS FOR CONTRACTOR:

Please complete this form with as much information as available.

If you have an assigned Sherwin Williams Paints Sales Representative or a Home store that services your account please contact them directly with this form.

If you do not have a Sherwin Williams Paints assigned account manager please email this form to Christopher Cook, email: christopher.t.cook@sherwin.com

This form must be forwarded to Sherwin Williams Paints prior to the start of any Capital Expenditure Project.

A job account must be assigned for every project.

INSTRUCTIONS FOR SHERWIN WILLIAMS PAINTS EMPLOYEES:

Upon receiving this form please open a job account for the paint contractor.

The job account must read as follows; Sprouts/Name of City.

11.01 *IA job account is strictly required for all Sprouts related projects.*

Upon opening a Sprouts job account, an email containing the 12 digit job account number is to be sent to Christopher Cook, Email: christopher.t.cook@sherwin.com for tracking purposes.

All Purchases associated with said project are to be made on this job account only.

Name of Contractor: _____

Sherwin Williams Paints Account Number (Existing): _____

Sprouts Job Account number (To be assigned): _____

Name and Address of Sprouts related Project: _____

_____

Name/Store of PPG Paints Contact: _____

Estimated Materials Needed: _____

Additional Comments/Needs of Contractor: (I.E renderings needed, drawdowns required, Special environmental restrictions: _____

_____

END OF SECTION 099000

SECTION 099300
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field application of stains.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 QUALITY ASSURANCE

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

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 STAINS AND TRANSPARENT FINISHES, GENERAL

A. Finishes:

1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each finish material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.02 EXTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood:
   1. Stain: Exterior semi-transparent stain for wood, water based; MPI #156.
      a. Products:
         1) PPG Paints Flood Pro Series Semi-Transparent Acrylic/Oil Stain, FLD832 Series. (MPI #156)
            a) Color: 707 - Tobacco
         2) SuperDeck Exterior Waterborne Semi-Transparent Stain, SD3T00025

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of stains and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Reinstall items removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099300

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SECTION 102600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

B. Equipment protection.

C. Cart rails.

D. Bollards.

E. Bumpers.

1.02 SUMMARY

A. This Section specifies the construction of all Protective Bumper System components, including but not limited to wall and corner guards and related items including appurtenances, installation, blocking, fasteners, adhesives, and sealants.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, deliver, transport, and install all protective bumper system work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication/procurement of guards and associated fastening, cutting, fitting, and cleaning.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Corner guards fabricated from rolled metal sections or bent plate.

1.04 QUALITY ASSURANCE

A. specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Certification: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

E. Testing: As required to be the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. Unless noted otherwise, this Specification is based on products manufactured by McCue Corporation, Tel: (800) 800-8503, www.mccuecorp.com.

H. All products shall be furnished by a single source.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Coordination: Coordinate with all other trades whose work relates to items specified herein for placing of all required backing and furring, to ensure proper locations.

B. Verify all dimensions shown on drawings by taking field measurements. Proper fit and attachment of all parts is required.

C. Materials must be acclimated in an environment of 65 deg F to 75 deg F for at least 24 hours prior to beginning the installation.

D. Interior installation areas must be enclosed and weatherproof prior to starting installation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: One (1) year commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PRODUCT TYPES

A. Systems Protector:
   1. Manufacturer: McCue Corporation, 13 Centennial Drive, Peabody, MA 01960, Phone: (800) 800-8503, www.mccue.com.
   2. Color: Safety Yellow
   3. Finish: Galvanzied.

B. Cart Rail – CartStop RE – CSR- (2A, 4A, 6A, 8A, 10A, 12A) series, Floor mounted rail system.
   1. Manufacturer: McCue Corporation, 13 Centennial Drive, Peabody, MA 01960, Phone: (800) 800-8503, www.mccue.com.
   2. Color: 401 - Black. (Interior Use)

C. Cart Rail – CartStop CSSSR (8A, 12A) series, Floor mounted rail system.
   1. Manufacturer: McCue Corporation, 13 Centennial Drive, Peabody, MA 01960, Phone: (800) 800-8503, www.mccue.com.
   2. Color: Color: Stainless Steel Kit
   3. Location: Only for use where storefront systems extend down to finished floor at slab and require protection. May be used in both exterior and interior conditions.

D. Bollards – Flex Core bollards
   1. Manufacturer: McCue Corporation, 13 Centennial Drive, Peabody, MA 01960, Phone: (800) 800-8503, www.mccue.com.
   2. Color: Safety Yellow.

E. Bumper: Streamline 2, polycarbonate bumper.
   1. Manufacturer: McCue Corporation, 13 Centennial Drive, Peabody, MA 01960, Phone: (800) 800-8503, www.mccue.com.
   2. Color: Black.

F. IdealShield EDGE SAFE SMART GATE - Model #ESG-96-PCY (*Only for use at Projects with Non-Proto exterior loading dock conditions*.)
   1. Install Anchorage: Base plated.
   2. Length: As shown on the Drawings.
   3. Style: Vertical lift.
   4. All components shall be hot dipped galvanized steel for exterior use.
   5. Finish: Powder coat safety yellow - factory finish.

G. IdealShield Standard Barrier Guardrail (steel rail sleeved in 1/4" yellow HDPE plastic.) (*Only for use at Projects with Non-Proto exterior loading dock conditions*.)
   1. Install Anchorage: Base plated.
   2. Length: As shown on the Drawings.
   3. Style: Standard-duty, two-line.
   4. All components shall be hot dipped galvanized steel for exterior use.

H. Sizes, and locations as indicated on the Drawings.

I. Attachment hardware shall be provided by the manufacturer and appropriate for wall construction.

J. Corner Guards - Stainless-Steel:
1. Corner guards, column wraps, base wainscots, Deli base angles, and equipment closure are to be as follows:
a. Corner guards are to be 2" x 2" angles or channels to fit wall thickness with 2" flanges.
b. Column wraps are as indicated on the Drawings.
c. Wainscot is to be one piece material with snap lock seams where necessary; prefer no seams (one piece) at janitor sink.
d. Base is to be 6" high with 3/8" radius cove at floor. Seams are to be butt joint with silicone sealant.
e. Deli base angle is to be 2 ½" high by 1 ½" leg, continuous length angle. All seams must overlap a minimum of 2" and screwed together.
f. Equipment closure required from the top of the oven and proofer to the ceiling. It is to be one material with snap lock seams where necessary, prefer no seams.
2. Material Type:
a. Stainless steel to be .030 gauge 304 series, polished #4 finish for guards, wainscot and equipment closure.
b. Stainless steel to be .024 gauge 300 series, polished #4 finish for coved base and Deli base angle.
3. Width of Wings: 2 inches.
4. Corner: Square.
5. Color: As indicated.
6. Length: One piece.
7. Installation: Caulk top edge to wall or column. Caulk bottom to floor. Use clear silicone sealant.

K. Corner Guards - Galvanized Steel:
1. Corner guards fabricated from rolled section or bent plate are specified in Section 055000 .
2. Width of Wings: 2 inches.
3. Length: One piece.
4. Location: at outside corners and coolers where not exposed to public view.

2.02 FABRICATION

A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.
   1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Take all necessary precautions to prevent damage to material during installation

C. Complete finishing operations, including painting if required, before installing impact-resistant wall-protection system components.

D. Install impact-resistant wall-protection units level, plumb, and true to line without distortions.

E. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

F. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

G. Immediately after completion of installation, clean plastic covers and accessories.

H. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

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SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Diaper changing stations.

1.02 SUMMARY

A. This Section specifies the construction of all toilet accessories and related assemblies including coordination, installation, shelves, bars, dispensers, receptacles, fasteners, templates, temporary supports, reinforcing, grout, sealants, paint, testing, and finishing, and cleaning.

B. Contractor shall provide all labor, materials, equipment, and services necessary to deliver, transport, receive, and install all Toilet Accessory work, as indicated on the Drawings, in accordance with local codes and standards, and as specified herein. This work shall include but not be limited to design and fabrication/procurement of toilet accessories and associated fastening, coordinating, positioning, welding, grouting, reinforcing, cutting, fitting, cleaning and painting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

D. Sprouts contracted supplier: As indicated on the Drawings.

1.03 REFERENCE STANDARDS

A. ASTM C1036 - Standard Specification for Flat Glass; 2025.

B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

C. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein.

C. Certification: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Manufacturer's instructions for installation shall be delivered and stored with the materials.

E. Testing: As required by the latest industry codes and standards.

F. Tolerances shall conform to industry codes and standards, except as otherwise noted.

G. This Specification is based on Products as manufactured by Bobrick Dispensers, unless otherwise noted.

1.05 FIELD CONDITIONS

A. Review Drawings for locations of toilet accessories and verify dimensional requirements for recessed units. Coordinate location of blocking and built-in anchorage devices.

B. Notify Owner's Representative of any conflicts with accessory locations and partition dimensions or piping interference.

C. Use concealed fastening wherever possible.

D. Provide anchors, bolts and other necessary fasteners, and attach accessories securely to walls and partitions in locations as shown or directed.

E. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same areas, wherever possible.

F. Stamped names or labels on exposed faces of units will not be permitted, except where otherwise specified.

1.06 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.

1.07 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Two (2) years commencing on Date of Substantial Completion.

C. 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Bobrick: www.bobrick.com/#sle

2.02 MATERIALS

A. Products as manufactured by Bobrick and supplied by Sprouts National Account Vendor, unless otherwise noted below.

B. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.03 Commercial Toilet Accessories

A. Toilet Tissue Dispenser.
   1. Model – As selected by Tenant
   2. Furnished by Sprouts Farmers Market.

B. Soap Dispenser.
   1. Model – As selected by Tenant.
   2. Furnished by Sprouts Farmers Market (Ecolab).

C. Mirrors: Stainless steel framed, 6 mm thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: 24" x 36" and 48" x 36".
   3. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners; satin finish.
   4. Products:
      a. Meek Mirrors, Model 1210-3648.5 and Model 1210-2436: www.meekmirrors.com

D. Toilet Seat Cover Dispenser:
   1. Model: As selected by Tenant.
   2. Furnished by Sprouts Farmers Market.

E. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 300 pound-force, minimum.

b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
c. Length and Configuration: As indicated on drawings.
1) Size: 18”, 36” and 42” lengths.
d. Products:
1) American Specialties, Inc; Model 3800 series, type -01.: www.americanspecialties.com/#sle.

F. Sanitary Napkin Disposal:
1. Type: Surface Mounted.
2. Products:
a. Bobrick; Model – B-270: www.bobrick.com

G. Hand Dryer and Accessories:
1. Excel Dryer Inc.; www.exceldryer.com
a. Xlerator Hand Dryer, Model – XL-W
1) 208V - 7.08 Amps - 60 Hz.
b. XChanger Combo Kit or ADA XChanger Combo Kit where indicated on drawings, Color: Brushed Stainless Steel
2. Location: Where indicated on the Drawings.

2.04 Diaper Changing Stations

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Polyethylene.
2. Mounting: Surface.
3. Color: Light Gray..
4. Minimum Rated Load: 250 pounds.
5. Products:
a. Foundations Worldwide, Inc: 100-EV, Vertical Wall Mount; www.foundations.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

C. Verify exact location of accessories for installation.

D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on the Drawings.

D. General: Install the work of this Section in accordance with the manufacturer's written instructions and recommendations, anchoring components firmly into position for long life under hard use.

E. Coordination: Coordinate with other trades as required, to assure proper and adequate provisions in the work of those trades, for interface with the work of this Section. Coordinate schedules for installation of the orderly progress of the total construction sequence.

F. Deviation of site conditions contrary to approved shop drawings shall be called to the attention of the Owner Representative.

G. Install all toilet accessories at locations indicated, in strict accordance with manufacturer's printed instructions.

H. Install concealed mounting devices and fasteners fabricated of the same material as the accessories or of galvanized steel.

I. Install exposed mounting devices and fasteners finished to match the accessories.

J. Provide theft-resistant fasteners for all accessory mountings.

K. Secure toilet room accessories to adjacent walls and partitions in accordance with the manufacturer's instructions for each item and each type of substrate construction.

L. Install grab bars in accordance with manufacturer's printed instructions at locations indicated.
   1. Install connectors or support angles between studs.
   2. Accurately position connector assemblies and tighten to the support angles before wall finish is applied.
   3. After wall surface is finished, secure concealed mounting plate to connector assembly using stainless steel machine screws furnished by the manufacturer.
   4. Where grab bars installed on toilet compartments make through-bolted connection with specified anchors.

3.04 CLEANING

A. Upon completion of this portion of the work, promptly clean exposed portions and remove traces of dirt, grease and all other foreign materials in accordance with manufacturer’s written recommendations and as directed by Architect.

3.05 PROTECTION

A. Upon completion of the installation, visually check exposed surfaces of the work of this Section and touch up scratches and abrasions so they are completely invisible to the unaided eye from a distance of 5'-0".

B. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 111319
STATIONARY LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Recessed loading dock leveler (with head and side pads and bumpers).

B. Existing Dock Equipment.

C. Manual wheel chocks.

D. Loading Dock Lights.

1.02 SUMMARY

A. This Section specifies the construction of all dock assemblies and related accessories including installation, ramp, platform, inserts, anchoring devices, seals, bumpers, levelers, controls, safety devices, lips, painting, wheel chock, coolhead (lighting), Sprouts logo, dock door and testing.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, deliver, transport, and install all dock facilities work, as indicated on the Drawings or as specified herein. This work shall include but not be limited to design and fabrication of dock, and associated welding, reinforcing, support of other work, fastening, fitting, cleaning, testing, and adjusting.

C. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

1.04 REFERENCE STANDARDS

A. ANSI MH30.1 - Design, Testing, and Utilization of Dock Leveling Devices; 2022.

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

C. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit.

C. Shop Drawings: Indicate required opening dimensions and tolerances, perimeter conditions of construction, placement dimensions of safety lock devices, and diagrams for power, signal, and control wiring.
   1. Clearly show layout, designation, number, model, type, location and materials required.
   2. Provide setting, drawings, templates, instructions and directions for installation of anchorage devices.
   3. Include plans, elevations, sections, details, and attachments to other work.
   4. Include wiring diagrams.
   5. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   6. Submit Shop Drawings showing but not limited to product (length, width and depth); hydraulic leveler to include pit dimensions, anchorage of curb angle and embedded plates.

D. Manufacturer's Qualification Statement.

E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.

F. Installer's Qualification Statement.

G. Material certificates for each type of product indicated. Include statements of material properties indicating compliance with requirements, standards, and type designations within standards. Include material test reports substantiating compliance with requirements.

H. Maintenance Data: Provide unit maintenance information, lubrication cycles, and spare parts manual.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience. Manufacturers shall meet the industry standards and codes for the materials identified on the Drawings and in the Specifications herein:
   1. Inserts and anchorages: Furnish inserts and anchoring devices which must be set in concrete for the installation of units.
   2. Field verify dimensions to ensure that specified equipment properly conforms to the actual driveway grades, equipment, dock height, and door size.

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

1. Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.
2. Manufacturers authorized representative who is trained and approved for installation of units required for this Project.

C. Certification: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Conduct pre-installation Conference at Project site.

E. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

F. Testing: As required to be the latest industry codes and standards.

G. Tolerances shall conform to industry codes and standards, except as otherwise noted.

H. Gross weight of fork lift and load shall not exceed 12,500 lbs.

1.07 EXISTING LOADING DOCK EQUIPMENT

A. All existing (to remain) Loading Dock Equipment is to be in a like new condition. All equipment is to be void of rust, broken sections, holes and tears. Repair dock equipment as required and install all missing bolted, welded fastenings to insure a safe, solid and secure installation of all equipment. Missing equipment that is required as a part of the total loading dock package (as identified in this Section) is to be provided by the General Contractor. All Loading Dock Equipment is to be inspected by the dock equipment manufacturer's representative prior to any work being done.

B. Existing Dock Leveler is to be in a like new condition. All equipment is to be void of rust, broken assemblies, cracked or broken hydraulic systems, nonfunctioning operators/fuses and the leveling unit is to be structurally secured to the loading dock. Dock Leveler is to be inspected by the dock equipment manufacturer's representative prior to any work being done.

C. Existing Dock Leveler to be provided with at least the following:
1. All items listed above for an operational and safe leveling unit.
2. Dock leveler control box shall be UL-approved on power assisted leveling unit.
3. Controls shall incorporate an “Overhead Door Interlock”. Overhead door must be opened before leveler is operable.
4. If any or all of these items are not provided with the existing leveler, General Contractor is to provide them as a part of his scope of work to Sprouts at store turnover.

1.08 FIELD CONDITIONS

A. Existing Conditions: Field verify dimensions of construction related to stationary loading dock equipment prior to fabrication, including recessed pit dimensions, slope of inclined dock approach, dock height, and height and width of dock door openings.

B. Recessed Loading Dock Equipment Coordinate size and location of pits to ensure proper clearances and operation of equipment.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer agrees to correct defective work within two year period from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Recessed Loading Dock Levelers:
   1. Overhead Door Company; Model M78R; www.overheaddoor.com.
   2. Wayne Dalton Company; A Division of Overhead Door; Model M78WD; www.wayne-dalton.com
   3. Substitutions: Not permitted.

2.02 RECESSED LOADING DOCK LEVELERS

A. Recessed Loading Dock Levelers: Provide manufacturer's loading dock leveler, in compliance with ANSI MH30.1 requirements, and of capacity, size, and construction as indicated, consisting of a nonslip steel platform, complete with controls, safety devices, and required accessories. Dock leveler shall meet ANSI MH14.1-1987 test load specifications with proper documentation from a 3rd party.
   1. Recessed Concrete Pit: Provide preformed concrete pit sized to fit dimensions of specified loading dock levelers.
      a. Ensure concrete slab is reinforced as required to support dock leveler.
      b. See Section 033000 for additional cast concrete requirements.
   2. Rated Capacity: Capable of supporting 35,000 lbs without permanent deflection or distortion.
   3. Platform Width: 7 feet.
   4. Platform Length: 8 feet.
   5. Platform Frame:
      a. Heavy structural steel, welded and reinforced to meet specified performance requirements and to provide rigid support for the unit.
      b. Angle between side and rear, and side and front curb angles must be 90 degrees.
      c. All curb angle joints to be welded securely.
   6. Toe Guards: Provide open sides of dock leveler with metal toe guards, equipped for entire upper operating-range.
   7. Range of Operating: Dock levelers to compensate for height differences between truck bed and loading platform, as follows; 12 inches above dock level, and 12 inches below dock level.
   8. Ramp Edge Extension Length: 18 inches long.
   9. Automatic Vertical Compensation: Floating travel of dock leveler ramp edge extended to automatically compensate for upward and downward movement of truck bed during loading and unloading operations.

10. Automatic Lateral Compensation: Tilting of dock leveler ramp edge extended and resting on truck bed to automatically compensate for canted truck bed up to 4 inches over width of ramp.
11. Ramp Edge Operation: Manufacturer's standard mechanism that automatically extends and supports hinged ramp edge and rests on truck bed over dock leveler's working range, allows ramp edge to yield under incoming truck impact and automatically retracts ramp edge when truck departs.

B. Mechanical Operating System: Manually controlled, with counterbalance and spring operation; spring-operated raising and walk-down lowering of unloaded ramp.
1. Provide dock leveler with upward-biased-spring counterbalancing mechanism controlled by hold-down device; ramp is raised to top operating range limit by operating recessed control handle to disengage hold-down device; ramp is lowered below platform level by operating auxiliary recessed control handle releasing supporting legs.
    a. Mechanical Fallsafe: Manufacturer's standard protection system to prevent platform from falling below dock level.
    b. Provide safety stops to limit fall of platform to 3” and 7” below dock. Safety stops to be integral part of manufacturers standard dock levelers.

C. Construction: Fabricate loading dock leveler frame, edge and platform supports from structural and formed steel shapes, with platform and hinged edge welded to supports, chamfer edge to minimize obstructing material-handling vehicles, and ensure entire assembly is fabricated to withstand deformation during operation and storage phases of service.
1. Ramp Traffic Support: Provide support for ramp at platform level in stored position with ramp edge retracted, and means to release supports allowing ramp to descend below platform level.
2. Ramp Maintenance Support: Provide mechanism in framework to support ramp in up position during dock leveler maintenance.

D. Integral Steel Faced / Molded Rubber (2) Dock Bumpers: Fabricate from 4 inch thick, 10 inches high, heavy-duty molded rubber reinforced compound; with Type A Shore durometer hardness of 80, plus or minus 5, when tested in accordance with ASTM D2240.
1. Provide two dock bumpers for each loading dock leveler, anchored to face of loading dock with expansion bolts.

E. Finish: Manufacturer’s standard paint applied to factory-assembled and tested loading dock levelers prior to shipment.
1. Color of Surfaces: Manufacturer's standard color.
2. Color of Toe Guards: Paint with yellow and black stripes.

F. Dock Seal with Head Pad:
1. Model:
    a. Overhead Door - Fixed Dock Seal Model LX10R.
    b. Wayne Dalton - Model KX10WD.
2. Dock seal to be compression style designed for 8’ x 8’ opening, 48” dock height, level approach, 4” cantilevered wall dock face, 4” bumper protection up to 3% dock slope and 6” bumper projection up to 4% dock slope.
3. Range of truck heights to be serviced shall be from 12’-6” to 13’-6".

4. Beveled side pads shall provide a tight seal between the back of the trailer and the building wall.
5. Dock seal shall have a stationary head pad.
6. Bottom of head pad shall have plated vent openings.
7. Dock seal shall have overlapping wear pleats on ends of head pad face.

2.03 LOADING DOCK LIGHTS

A. Dock Light shall be painted Safety Yellow and made from 1-1/2", 14 gauge steel square tube arms.

B. Dock Light shall have double-strut arm assembly with single-arm attachment head.

C. Dock Light shall have a 110-volt plug in connection with an on/off toggle switch on 16" cord connecting head to arm.

D. Model:
1. APS Resource Model DL-40P with 42" flex arm.
2. Overhead Door / Wayne Dalton - LED Carbonate housing, Dual Arm, Part #850300-001 with 40" reach.

2.04 MANUAL WHEEL CHOCKS

A. Manual Wheel Chocks: Provide truck trailer wheel chocks, two per loading dock, in compliance with applicable OSHA requirements.
1. Wheel chock shall be 7" H x 9" W x 7" L rubber with 20'-0" of corrosion-resistant chain supplied with each chock. Include optional "Truck Wheels must be Chocked" sign. One per dock leveler by APS Resource.
2. Bracket: Wall mounted metal bracket for storage of chock and chain when not in use.
3. Chock Model:
   a. Overhead Door / Wayne Dalton - Model 850307.0001

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine loading dock equipment area for compliance with requirements for installation tolerances and other conditions related to this work.

B. Examine rough-in for electrical systems of loading dock equipment to verify openings and locations are acceptable prior to installation of equipment.

C. Examine walls and floors of loading dock equipment concrete pits for suitable conditions, verify that pits are plumb and square, and properly sloped back to front of loading dock for drainage.

D. Proceed with installation after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare loading dock equipment for size and locations as indicated, and provide anchoring devices with templates, diagrams, and installation instructions.

3.03 INSTALLATION

A. Installer shall examine all dimensions and conditions under which the equipment is to be installed and notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Install loading dock leveler unit in prepared opening in accordance with manufacturer's written instructions.
   1. Set square and level.
   2. Anchor unit securely, flush with dock, and weld back of leveling dock to pit frame; touch-up welds with primer.
   3. Install electrical connections as required for fully operational system.

C. After installation is complete, a representative of the Manufacturer shall examine the installation and require that all connections and adjustments necessary to assure proper operation of all equipment be made. Before acceptance, a demonstration shall be conducted in the presence of a Sprouts Farmers Market representative to guarantee that all equipment is operating properly in every respect. In addition, a detailed user/operator training session shall be conducted at time and place agreed upon by Sprouts Farmers Market representative and Manufacturer's representative.

D. Provide closeout documents as required in Division 1.

E. Manual Wheel Chocks: Install in accordance with manufacturer's written instructions.

3.04 CLEANING

A. Clean recessed pits of debris.

END OF SECTION 111319

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SECTION 123600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall-hung counters and vanity tops.

1.02 SUMMARY

A. This Section specifies the construction of all solid surface countertops, and related items including but not limited to: sinks and bowls, wood cabinets, trim, framing, laminate countertops, wood furring, blocking, shims, hanging strips (unless concealed within other construction before woodwork installation), hardware, finishing and installation.

B. Contractor shall provide all labor, materials, equipment, and services necessary to design, furnish, deliver, and install all solid surface countertops, and related items as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to design and fabrication of woodwork, casework, trim, laminate countertops, and associated cutting, fitting, aligning, fastening, coping, bracing, reinforcing, cleaning and finishing.

C. Solid surface countertops shall be purchased from manufacturer / distributor, received and stored by General Contractor, and installed by Contractor. Refer to Part 2 Products for contact Information.

D. Field Dimensions: The fabricator / installer is responsible for details and dimensions not controlled by job conditions and shall show on his shop drawings all required field measurements beyond his control.
   1. The General Contractor and the fabricator / installer shall cooperate to establish and maintain these field dimensions.
   2. Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

E. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

B. AWI (QCP) - Quality Certification Program; Current Edition.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: The approved fabricator / installer must have a minimum of three (3) years experience in fabrication and installation of solid surface materials, or certification by Distributor, and a reputation for doing satisfactory work on time and shall have successfully completed comparable work. The Architect, and or Owner reserves the right to approve the fabricator / installer selected to furnish all of the work as outlined in this specification.

B. Quality Certification:
1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

C. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

D. Testing: As required by the latest industry codes and standards.

E. Tolerances shall conform to industry codes and standards, unless otherwise noted.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

B. Warranty Period: Ten (10) years commencing on Date of Certificate of Occupancy.

C. Additional requirements for product warranties are included in Section 016000.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Staron Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate with integrated sink bowl.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness, complying with ANSI Z-124.3 and Z-124.6, Type 6.
      a. Manufacturers:
         1) LOTTE Chemical, 6 Centerpointe Drive, Suite 100, La Palma, CA 90623, Tel: (813) 815-1588, Website: www.staron.com.
         2) Substitutions: Not permitted.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Performance Characteristics:
         1) Class A – Test method ASTM E84 and UL 723.
         2) Food Zone use – NSF 51
      d. Finish on Exposed Surfaces: As indicated on the Drawings..
      e. Color and Pattern: As indicated on drawings.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

C. Sinks and Bowls: Homogenous casting composed of a blend of natural minerals and 100% acrylic resin (methyl methacrylate) complying with ANSI Z-124.3 and Z-124.6, Type 6.
   1. Model number: As indicated on the drawings.

2. Color: As indicated on the drawings.

D. Countertop perimeter frame: 1/2", 12.3 mm, moisture resistant plywood, or 1/2", 12.3 mm, moisture resistant MDF.

2.02 ACCESSORIES

A. Joint and Laminating Adhesive for bonding Staron Sheet to Staron Sheet: Two component Staron Joint Adhesive Drawer Guides: KV 1260.

B. Adhesive for bonding Staron Sheet to other materials: 100% silicone sealant complying with ASTM C920.

C. Fixed Top-Mounted Countertop Support Brackets:
1. Material: Stainless Steel.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 123600

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SECTION 124813
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet mat.

B. Recessed mat frames.

1.02 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Floor Mats:
   1. Matworks Company www.thematworks.com.

2.02 FLOOR MATS

A. Carpet Mat: Blend of polypropylene and polyethylene terephthalate (PET) with bitumen backing.
   1. Product: Ambassador Tiles (floor entrance tiles and frame).
   2. Size: 19.69" x 19.69".
   3. Color: Charcoal.

B. Recessed Frame: Manufacturer's standard extrusion.
   1. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
   2. Color: As selected by the Architect from manufacturer's full range of colors.

2.03 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregates no larger than one-third fill thickness.

2.04 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

C. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

D. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
   1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

E. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

C. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

D. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

3.04 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

END OF SECTION 124813

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SECTION 129300
SITE FURNISHINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Trash Receptacles

B. Ash Receptacles

C. Cart Corrals

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

G. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2025.

H. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.03 SUMMARY

A. This Section includes the procurement and installation of trash and ash receptacles, and cart corrals.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all site furnishing work as indicated on the drawings, as specified herein, and in accordance with local codes and standards. This work includes but is not limited to furnishing and installing trash receptacle, grout, concrete, reinforcing anchors, attachment to other installations, and miscellaneous items as required to provide a complete and secure installation.

C. Related Sections: Section 033000 - Cast-In-Place Concrete for installation of pipe sleeves and installation of anchor bolts in cast in concrete slabs.

D. Products furnished, but not installed under this Section include pipe sleeves and anchor bolts to be cast in concrete footings.

E. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.04 QUALITY ASSURANCE

A. Installation of all products in this specification shall conform to ADA requirements and local codes and standards.

B. Manufacturer's instructions for installation shall be delivered and stored with the materials.

C. Source Limitations: Obtain each type of site through one source from a single manufacturer.

D. Warranty: Manufacturer's shall provide a warranty for materials for a period of two (2) years, commencing on Date of Substantial Completion.

E. Repair: All warranties shall repair and/or replace of any part of the premises or equipment required as a result of defects in materials or damage caused during construction. Repair/replacement shall be performed to the satisfaction of the Sprouts CPM at the Contractor's expense.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements for product delivery, storage and handling in Section 016000.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Trash Receptacles
      a. As manufactured by Safco, Purchased through Grainger, Inc., 7775 E. Baseline Rd., Gilbert, AZ 85233, Tel.: (480) 308-7980.
      b. Model: Canmeleon, Aggregate Panel, 9472NC
      c. Color: Black
   2. Cigarette (Ash) Waste Collector

a. As manufactured by Rubbermaid, Purchased through Staples, Inc.
b. Model / SKU number fg257088BLA "Groundkeeper"
c. Color: Black

3. Cart Corrals as manufactured by Win-holt Equipment Group, 592 Brook Street, Garden City, NY 11530, Tel.: (800) 444-3595, Fax: (516) 921-0538. Provided and installed by General Contractor.
   a. Model number CCRL-1S1R-614-SPTS.
   b. Material: Galvanized Steel

2.02 MATERIALS

A. Steel: Free from surface blemished and complying with the following:
   1. Plates, Shapes and Bars: ASTM A36/A36M.
   2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53/A53M, or electric-resistance-welded pipe complying with ASTM A135/A135M.
   3. Tubing: Cold-formed steel tubing complying with ASTM A500/A500M.
   4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513/A513M, or steel tubing fabricated from steel complying with ASTM A1011/A1011M and complying with dimensional tolerances in ASTM A500/A500M; zinc coated internally and externally.

B. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated materials, commercial quality, vandal and theft resistant, concealed and capped. Provide as required for site furnishings' assembly, mounting and secure attachment.
   1. Anti-theft Hold-Down Brackets: For securing site and street furnishings to substrate; two per unit, minimum embed: 3".

C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

D. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
   1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz/sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81%, not less than 0.3-mil-thick, zinc pigmented coating.
   2. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or ASTM A924/A924M.

2.03 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipe and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Factory Assembly: Assemble components in the factory to the greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.04 FINISHES, GENERAL

A. Comply with NAAMM AMP 500-06's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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 the same piece are not acceptable. 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.

2.05 STEEL AND GALVANIZED STEEL FINISHES

A. Bakes-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester-TGIC, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finish grade, mounting surfaces, installation tolerances, and other conditions affecting performance.

B. Notify Owner/Owner's Representative in writing within 48 hours of unsatisfactory condition/defects which could be detrimental to the Contractor's work.

C. Verify dimensions and coordinate work in this section with the work of other trades.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site and street furnishings, where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored, positioned at locations indicated on Drawings, as specified herein, and per local codes and standards.
   1. Vandal-proof bolts as approved by Owner's Representative.
   2. Paint all hardware to match specified furnishings.

D. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.03 CLEANING

A. After completing site and street furnishing installation, inspect components and premises.

B. Remove spots, dirt, and debris.

C. Repair damaged finishes to match original finish or replace component/premises at the discretion of the Sprouts CPM.

END OF SECTION 129300

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SECTION 129313
BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 SUMMARY

A. This Section includes the procurement and installation of exterior bicycle racks.

B. Contractor shall provide all labor, materials, equipment, and services necessary to furnish, transport, and install all site furnishing work as indicated on the drawings, as specified herein, and in accordance with local codes and standards. This work includes but is not limited to furnishing and installing bicycle racks, grout, concrete, reinforcing anchors, attachment to other installations, and miscellaneous items as required to provide a complete and secure installation.

C. Related Sections: Section 033000 - Cast-In-Place Concrete for installation of pipe sleeves and installation of anchor bolts in cast in concrete slabs.

D. Products furnished, but not installed under this Section include pipe sleeves and anchor bolts to be cast in concrete footings.

E. Coordinate delivery with other work to avoid delay. All work shall be coordinated with other sections.

1.03 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.04 QUALITY ASSURANCE

A. Installation of all products in this specification shall conform to ADA requirements and local codes and standards.

B. Manufacturer's instructions for installation shall be delivered and stored with the materials.

C. Source Limitations: Obtain each type of site through one source from a single manufacturer.

D. Warranty: Manufacturer's shall provide a warranty for materials for a period of two (2) years, commencing on Date of Substantial Completion.

E. Repair: All warranties shall repair and/or replace of any part of the premises or equipment required as a result of defects in materials or damage caused during construction. Repair/replacement shall be performed to the satisfaction of the Sprouts CPM at the Contractor's expense.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks and accessories with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. MADRAX, a brand of Graber Manufacturing, Inc; HW238-5-IG-P and HW238-7-IG-P: 2700 Laura Lane, Middletown, WI, 53562, Tel.: (800) 448-7931, Fax: (602) 831-7623, www.madrax.com/#sle.

2.02 BICYCLE RACKS AND ACCESSORIES

A. Exterior Bicycle Racks: Device designed for indoor storage of bicycles; allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Capacity: Reference Drawings for quantity of bicycles.
   2. Finish: Powder coat, maintenance-free and weather-resistant.
   3. Color: Black.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks and accessories..

B. Do not begin installation until unsatisfactory substrates have been properly repaired.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle racks and accessories are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle racks and accessories level, plumb, square, and correctly located as indicated on drawings.

C. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 129313

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SECTION 129314
BICYCLE LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle lockers.

1.02 REFERENCE STANDARDS

A. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.

B. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bicycle Lockers:
   1. Duracore; www.duracore.com.
   2. Substitutions: Not permitted.

2.02 BICYCLE LOCKERS (For California Projects or as required by the AHJ)

A. Galvanized Steel Exterior Bicycle Lockers: Secure storage enclosure fabricated of steel panels with factory applied finish and factory installed hardware.
   1. Style: DL1.
   2. Capacity: 1 bicycle per unit.
   3. Panels: Steel sheet, 16 gauge, 0.0598 inch minimum thickness.
   4. Door and Frame: Steel sheet; 16 gauge, 0.0598 inch minimum thickness, door factory hung and adjusted.
   5. Hardware:
      a. Door Hinges: Full length, piano type hinges of 14 gauge, 0.0781 inch minimum thickness.
      b. Lock Hardware: Manufacturer's standard pad lock handle.
   6. Mounting, Ground: Leveling and anchoring system consisting of feet adjustable up to 5 inches vertically and flanges suitable for bolts or post-installed anchors. Install per manufcturer's instructions.
   7. Finish: Powder coat, factory applied over primer.
   8. Color: Mesa Tan.

B. Materials:
   1. Galvanized Steel - ASTM A879/A879M, 16 gauge.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle lockers.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle lockers are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle lockers level, plumb, square, and correctly located as indicated on drawings.

C. Post-Installed Anchors: Comply with ICC-ES AC308 and manufacturer's instructions.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 129314

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DIVISION 20 - SEISMIC CONTROLS FOR MEFPT SPECIFICATION

200548 Seismic Controls for MEP/F/T Systems

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SECTION 200548
SEISMIC CONTROLS FOR MEP/F/T SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This section includes requirements for seismic controls to be installed for project, the design for which is a delegated design responsibility.

1.02 DEFINITIONS

A. Section Title: Seismic Controls for Mechanical, Electrical Plumbing, Fire Protection, and Technology (MEP/F/T) Systems.

B. IBC: International Building Code.

C. ICC-ES: ICC-Evaluation Service.

D. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.03 ADMINISTRATIVE REQUIREMENTS

A. The contractor shall be responsible for determining the requirements for seismic control measures to be applied to HVAC piping and equipment, electrical conduit and raceways, electrical switchgear and plumbing systems specified herein. Seismic protection criteria used to determine seismic control requirements of all mechanical, electrical and plumbing systems shall be determined by the applicable code adopted in the project jurisdiction. Where not already determined within the contract documents, the contractor shall be responsible for contracting a licensed professional engineer to establish building site class, seismic use group, occupancy category, seismic design category, seismic zone or any other criteria necessary to determine the requirements for seismic control measures for mechanical, electrical and/or plumbing systems.

B. Where required, the Contractor shall be responsible for determining the type and location of seismic supports required for the HVAC piping and equipment, electrical conduit and raceways and plumbing elements shown on the contract drawings based on the seismic criteria, the size and weight of the supported element and the distance from structure that the element will be installed. The Contractor shall submit shop drawings as defined in Paragraph “Submittals” showing the types and locations of required seismic supports.

C. The requirements for seismic control measures to be applied to HVAC piping and equipment, electrical conduit and raceways, electrical switchgear and plumbing systems specified herein are in addition to any other items called for in other sections of these specifications. All anchor connections to structure for support of mechanical/electrical equipment, regardless of the need for seismic restraints, shall be shown on shop drawings and submitted for review by the Engineer of Record.

D. The Contractor may at his option, use pre-engineered seismic restraints produced by the manufacturers specified in part 2.1 of this section. Spacing of seismic restraints may be modified in these pre-engineered systems to meet seismic design parameters when properly engineered and documented.

E. All seismic restraints, isolators, and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.

F. Seismic protection systems shall be installed in strict accordance with all applicable local, state, and/or federal codes. Installation shall also be in strict accordance with component manufacturer's requirements and standards and with industry construction standards. Whenever conflicts occur between codes or standards, the most stringent shall apply.

G. Seismic protection of fire protection piping systems shall be installed in strict accordance with the provisions of NFPA 13 (2010 or later edition).

1.04 SUBMITTALS

A. Seismic Control Measure Analysis: The contractor shall provide an analysis determining the requirement or exemption for seismic control measures for mechanical, electrical and plumbing equipment. The analysis shall be signed and sealed by a licensed professional structural engineer.
   1. The analysis shall at a minimum include the following:
      a. For projects permitted under Uniform Building Code
         1) UBC Seismic Zone
         2) Seismic Zone Factor
         3) Occupancy Category
      b. For projects permitted under International Building Code
         1) Seismic Use Group or Building Category.
         2) Seismic Design Category
         3) Site Class
         4) Design Spectral Response Acceleration Values
      c. For projects with equipment mounted outdoors and subject to wind restraint requirements:
         1) Basic Wind Speed.
         2) Building Classification Category
         3) Minimum 10lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Where seismic control measure analysis determines seismic controls are not required:
   1. Submit report that summarizes the analysis for review and approval.
   2. Disregard the remaining portions of this submittal section

C. Where seismic control measure analysis determines seismic controls are required:
   1. Submit report that summarizes the analysis for review and approval
   2. Provide submittals for seismic bracing as required in the remaining portions of this submittal section.

D. Product Data: The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

E. Delegated-Design Submittal: Submit seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators and seismic restraints.
    a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Seismic and Wind Restraint Details:
    a. Design Analysis: Submit report that supports 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.
    c. Preapproval and Evaluation Documentation: Where required provide preapproval documentation from an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

F. Shop Drawings: The following items shall be signed and sealed by a registered professional engineer:
1. Shop drawings along with catalog cuts, templates, erection, and installation details, as appropriate, for the items listed below shall be submitted for approval. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to other building systems and construction.
    a. Sway Braces
    b. Flexible Couplings or Joints
    c. Resilient Type Vibration Devices
    d. Equipment Anchor Connections
    e. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
    f. Details of suspension and support for ceiling hung equipment.

g. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.

h. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

2. Layout drawings showing locations and types of seismic restraints for all equipment, ductwork, piping and conduit shall be submitted. Locations for seismic restraints shall be coordinated with the structure and with other mechanical and electrical components. Coordinate types of restraints with the submitted schedule

3. Indicate components exempt from seismic due to exceptions for component importance factor, component response modification factor, component amplication factor, seismic design category, etc.

G. Seismic Certification and Analysis:

1. Seismic restraint calculations shall be provided for all connections of equipment to the structure. Calculations shall be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the project location.

2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Testing and calculations shall include shear and tensile loads as well as one test or analysis at 45° to the weakest mode.

3. Analysis shall indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the code required forces acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

4. Submit certification letter stating that the special inspector has received the factory training necessary to perform the field inspection specified in Part 3 of this specification.

H. Welding certificates.

1.05 QUALITY ASSURANCE

A. Professional Engineer Qualifications (Analysis): The professional engineer shall be licensed to practice in the jurisdiction where the project is located and shall be experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for building structural and seismic requirements.

B. Professional Engineer Qualifications (Design): The professional engineer shall be legally qualified to practice in the jurisdiction where the Project is located and shall be experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

D. Seismic Restraint Manual: A seismic restraint manual shall be prepared that contains the basis of the design for the seismic support systems, product data, shop drawings and layout drawings. A copy of the seismic restraint manual shall be kept on the jobsite for the duration of the project.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

F. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

G. Comply with NFPA 70.

1.06 SPECIAL INSPECTION

A. Requirements specified herein for special inspection of important aspects of the seismic design are in addition to other requirements specified in other sections of this specification.

1.07 HVAC EQUIPMENT

A. HVAC equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
   1. Mechanical Equipment including but not limited to:
      a. Boilers
      b. Expansion Tanks
      c. Heat Rejection Equipment
      d. Refrigerant Compressors
      e. Indoor Air Handling Equipment
      f. Rooftop Air Handling Equipment
      g. Packaged Rooftop Units
      h. HVAC Piping and Equipment Storage Racks
      i. Heat Exchangers
      j. Water Chillers
      k. Cooling Towers, Fluid Coolers, Condensing Equipment
      l. Control Panels
      m. Pumps with Motors
   2. HVAC (hydronic) Piping Systems
   3. HVAC Ductwork Systems

1.08 ELECTRICAL EQUIPMENT

A. Electrical equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
   1. Major Electrical Distribution Equipment including but not limited to
      a. Panelboards
      b. Switchgear
      c. Transformers
      d. Control equipment (time-clocks, contactor enclosures, etc.)
   2. Electrical Conduit and Raceways
   3. Electrical Bussways

1.09 PLUMBING EQUIPMENT

A. Plumbing equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
   1. Plumbing Equipment including but not limited to
      a. Water Heaters
      b. Heat Exchangers
      c. Water Softeners
      d. Expansion Tanks
      e. Air Compressors
      f. Vacuum Pumps
      g. Pumps with Motors
   2. Fuel Gas piping
   3. Fuel Oil Piping
   4. Medical Gas Piping

1.10 RELATED WORK

A. Housekeeping Pads
   1. The restraint vendor shall prepare housekeeping pad reinforcement and monolithic pad attachment to the structure details and design..
   2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Supplementary Support Steel
   1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc., as required or specified.

1.11 ATTACHMENTS

A. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic vendor's calculations.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Seismic Restraints: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following or approved equals:
   1. Amber/Booth Company, Inc.
   2. B-Line / Tolco.
   3. International Seismic Application Technology (ISAT).
   4. Kinetics Noise Control, Inc.
   5. Loos & Company, Inc.
   6. Mason Industries, Inc.
   7. Uni-Strut.
   8. Vibro-Acoustics.

B. Flexible Couplings: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following or approved equals:
   1. Barco Div.
   2. Flexonics, Inc.
   3. Hyspan.
   4. International Seismic Application Technology (ISAT).
   5. Mason Industries, Inc.
   6. Resistoflex.

2.02 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
   1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
   2. Fiberglass or cork isolator pads: molded cork or glass fiber not less than 1 inch thick and pre-compressed through 10 compression cycles at 3 times the rated load.
   3. Load range: from 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 1.0 times the rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to the structural design criteria. Contact the Engineer if design criteria is not shown on the drawings.
6. Top Plates: Provide threaded studs for fastening and leveling equipment.
7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Install elastomeric grommet at bottom connection for isolation between anchor bolt and base plate or housing.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.03 SEISMIC CONTROLS

A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

B. Manufactured Seismic Snubbers: All-directional snubbers.
   1. Construction: Interlocking steel members restrained by a 3/4-inch- thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.
   1. Construction: Welded steel shapes conforming to ASTM A 36.
   2. Resilient Components: 3/4-inch thick, replaceable, shock-absorbing neoprene insert.

2.04 VIBRATION ISOLATION BASES

A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
   1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
   2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
   3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
   4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
   5. Configure inertia bases to accommodate equipment supported.
   6. Pump Bases: Size to support pump and piping elbows.
   7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.05 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.
   1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer strip for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
   2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
   3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

2.06 MATERIALS

A. Bolts and Nuts:
   1. Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B18.2.2, and ASTM A307 or A 576.
   2. Bolts, underground, ASTM A 325.

B. Sway Brace: Except for pipes, material shall be structural steel conforming to ASTM A 36. Steel pipes shall conform to ASTM A 501.

C. Flexible Couplings: Flexible couplings shall have same pressure ratings as adjoining pipe. Where required by these specifications, flexible couplings shall be one of the following:
   1. Flexible ball joints conforming to the following requirements may be employed on aboveground piping. Joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement. Joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.
   2. Flexible metal hose type joints may be used for aboveground or underground piping, up to 8" pipe diameter. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

D. Resilient Vibration Isolation Devices:
   1. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as in paragraph "Anchor Bolts".
   2. Multidirectional Seismic Snubbers: Multidirectional seismic snubbers employing elastomeric pads shall be installed on all floor or slab-mounted equipment. Snubbers shall provide 0.25 inches vertical and horizontal clearances. Vertical forces shall be resisted by the snubber medium. Provide additional structural steel supports/frame necessary for equipment to insure proper restraint.
   3. Seismically Restrained Vibration Isolators: As an option to multidirectional seismic snubbers, a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions may be utilized. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer, neoprene or equal, to protect equipment.
   4. Restraints shall allow a maximum of 1/4" movement before engaging and shall not interfere in normal operation. Housing shall allow for visual inspection of the spring. The entire assembly shall have a certified minimum rating of 1g. in all directions. Submit test data from independent testing lab.
   5. Isolator shall be stable spring with a minimum Ky/Ky of 1.0 and the spring shall be isolated from the housing by an internal elastomeric pad on its base for sound absorption. Spring shall have a combination leveling bolt and equipment fastening device. Nuts and bolts shall be zone-electroplated to prevent corrosion. Adjusting bolt and equipment attachment shall have a minimum rating of 1g. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed.
   6. Baseplate shall have adequate means for bolting to the structure. If elastomeric pad for sound absorption is on baseplate of housing, anchor bolts shall be isolated with elastomeric grommets.

2.07 CABLE RESTRAINT

A. Restraint assembly for suspended equipment, piping and ductwork consisting of galvanized steel aircraft cable attached to galvanized steel thimbles or steel assemblies with two clamping bolts. Thimbles or assemblies shall be specifically designed for cable service, shall be able to swivel to final installation angle and shall be securely fastened to the equipment or equipment base and the building structure. Cables shall be sized for the force required per code with a minimum safety factor of 2.

PART 3 EXECUTION

3.01 INSTALLATION

A. General
   1. Install and anchor seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.
   2. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
   3. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.
   4. Fill concrete inertia bases, after installing base frame, with 3000-psig concrete, and trowel to a smooth, hard finish.
   5. Install pipe connectors at connections for equipment supported on vibration isolators.
   6. Install cables to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

B. Sway Braces for Piping, Conduit and Ducts
   1. Sway braces shall be installed on piping, conduit and HVAC ducts to preclude damage during seismic activity. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 1/2 inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where is would interfere with thermal expansion of piping.
   2. Sway Braces for Piping and Conduit:
      a. Horizontal Runs: Provide transverse and longitudinal sway bracing at intervals as required for the pipe size and seismic zone.
      b. Vertical Runs: Vertical runs of piping 1-1/2” or greater diameter shall be braced at not more than 10-foot vertical intervals. For piping smaller than 1-1/2” diameter, bracing shall be provided at no more than 4-foot spacing.
      c. Anchor Rods, Angles, and Bars: Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in place concrete or masonry insert of clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in Table III.
      d. Clamps: Clamps on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.

e. Bolts: Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3. Sway Braces for HVAC Ducts:
   a. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each duct run, and otherwise at intervals as required for duct size and seismic zone. Walls which ducts penetrate may be considered transverse braces.
   b. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at intervals as required for duct size and seismic zone. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and it is sized for the larger duct.

C. Piping and Conduit Penetration Requirements
1. All piping from 1 to 3-1/2 inches diameter shall be installed with 1" clearance on all sides and at every floor, and masonry or concrete wall penetration. A 2" clearance is required for pipe sizes larger than 3-1/2".
2. Insulated and uninsulated pipes and conduit passing through walls and partitions (except smoke and fire walls and partitions) shall be run through not less than No. 12 gauge steel pipe sleeves finishing flush with the finished wall surfaces. Where covered pipes pass through the walls or partitions, same shall be centered in steel pipe sleeves. All sleeves or thimbles shall be independent of the pipes they enclose and centered in sleeves to insure free movement of the pipes without injury to pipe insulation, wall or other finish. Caulk around all pipes and pipe sleeves passing through walls or ceilings with untarred jute and make airtight and soundproof.
3. Insulated and uninsulated pipes and conduit passing through fire, or fire and smoke walls and partitions shall be run through rated wall sleeve assemblies sealed with Hilti CS-240 firestop sealant or approved equal UL approved sealant meeting the approval of the authority having jurisdiction and as indicated on details on drawings.
4. Pipe sleeves through outside walls shall be Schedule 40 steel pipe sleeves with 1-1/2"collar welded to center of sleeve and cast in wall. Caulk between sleeves and pipes and make watertight.
5. Materials and equipment shall conform to the respective specifications and other requirements specified below:

D. Spreaders
1. Provide spreaders between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.

E. Flexible Couplings or Joints
1. Building Piping: Flexible couplings or joints in building piping shall be provided in the following locations on pipe risers:
   a. Within 24 inches of the top and bottom of all risers. This requirement may be deleted in risers less than 3 ft. in length, and in risers 3 to 7 ft. in length, one flexible coupling is adequate.

2. Underground Piping: All underground piping and 4-inch or larger conduit, except heat distribution system, shall have flexible couplings installed adjacent to building. Additional flexible couplings shall be provided as follows:
   a. On each side of the joints of demarcation between soils having widely differing degrees of consolidation.
   b. At all points that can be considered to act as anchors.
   c. On every branch of a tee and each side of an elbow.

F. Anchor Bolts
1. All floor or pad mounted equipment required by any Section of these specifications shall use cast-in-place or female wedge type anchor bolts. Anchor bolts must conform to ASTM A 307. Female wedge anchors shall have an evaluation report number from ICBA Evaluation Service. Anchor bolts shall have an embedded straight length equal to at least twelve times nominal diameter of the bolt. If the size and number of the anchor bolts are not shown on the drawings, then anchor bolts shall conform to the applicable codes and standards for the various equipment weights or the manufacturer's installation recommendations, whichever is the most stringent.

G. Equipment Sway Bracing
1. Provide for all items supported from overhead floor or roof structures with the following requirements:
   a. Braces shall consist of angles, rods, bars, or pipes secured at both ends with not less than 1/2 inch bolts. Braces shall conform to all applicable codes and standards. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 50 percent of the weight of equipment without exceeding safe working stress of bracing components. Details of all equipment bracing shall be submitted for approval.
   b. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90 degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are included at a 45 degree angle.

H. Ceiling mounted air terminals or services installed in lay-in ceilings
1. Positively attach to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

I. Miscellaneous Equipment
1. The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of

components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.
a. Air Handling Units
b. Free Standing Electric Motors

J. Floor Mounted Equipment Support
1. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.
2. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.02 ADJUSTING AND CLEANING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.

B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

3.03 SPECIAL INSPECTION

A. Special Inspector: Employ a factory trained representative during construction to observe the work specified and to ensure that it conforms to the Contract documents. Factory trained representative shall be a qualified person who shall demonstrate competence and specialized experience, to the satisfaction of the engineer of record, for inspection of the seismic protection of mechanical and electrical equipment.

B. Inspection Requirements: The factory trained representative shall periodically inspect the following systems to verify conformance with the contract documents and the local code:
1. Installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F.
2. Installation of HVAC ductwork that will contain hazardous materials in structures assigned to Seismic Design Category C, D, E or F.
3. Installation of vibration isolation systems in structures assigned to Seismic Design Category C, D, E or F where a nominal clearance of 0.25 inches or less between the equipment support frame and restraint is required.

C. Inspection Reports: Ensure that the inspection report is furnished from the special inspector to the engineer of record. At the end of the work, ensure that a final, signed report is submitted by the special inspector, stating whether the work requiring special inspection was, to the best of the special inspector’s knowledge, in conformance with the Contract documents.

D. Discrepancies: Discrepancies shall be brought to the immediate attention of the Contractor for correction, and then, if uncorrected, to the architect and engineer of record.

END OF SECTION 200548

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DIVISION 21 - FIRE SUPPRESSION SPECIFICATION

210010 GENERAL FIRE SUPPRESSION REQUIREMENTS
210500 COMMON WORK RESULTS FOR FIRE SUPPRESSION
210515 BASIC FIRE SUPPRESSION PIPING METHODS AND MATERIALS
210553 IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
211100 FIRE SUPPRESSION WATER SERVICE PIPING
211313 WATER BASED FIRE SUPPRESSION SYSTEMS

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SECTION 210010
GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 21 of the Specifications and Drawings numbered with prefixes F generally describe these systems, but the scope of the Fire Suppression work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general location and arrangement of the equipment, piping, etc. without showing all the exact details as to elevations, offsets, pipe routing, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
   2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
   3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
   4. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
   5. Division 21 Section 211100 “Fire Suppression Water Service Piping” for fire suppression piping starting 5 feet outside the building to within the building.
   6. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.02 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

F. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.

G. Regulatory Requirements: Comply with all standards listed in Section 1.2 and all applicable local requirements.

H. All electrical equipment provided, and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section, Division 26 and Division 28.

I. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.03 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the submission of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
   1. NFPA (National Fire Protection Association) 13, "Installation of Sprinkler Systems", 2019 Edition.
   2. NFPA 24, "Private Fire Service Mains and their Appurtenances", 2019 Edition.
   3. NFPA 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems", 2020 Edition.
   4. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
   5. Florida Building Code (IBC), 2023 Edition with local amendments.
   6. Florida Fire Code (IFC), 2023 Edition with local amendments.

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Fire Suppression work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Fire Suppression work shall be provided by the Contractor.

1.04 DEFINITIONS

A. General:
   1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
   2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
   3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
   4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
   5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
   6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
   7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.

8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    a. 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.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

D. Other definitions for fire protection systems are listed in NFPA Standards 13, 14, 20 and 24.

E. Working Plans, also referred to as Fire Protection Drawings as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the Authority Having Jurisdiction.

F. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Sub-base: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
3. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.05 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets

required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.

C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Fire Suppression systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect/Engineer. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

E. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire protection system shall include, but not be limited to:
   1. Sprinkler monitoring equipment (water flow switches, valve tampers, etc.) shall be provided by the fire sprinkler installer but wired and connected by Division 28.

F. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and described within the specification sections.

1.06 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.07 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Fire Suppression construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:
   1. The project name.
   2. The applicable specification section and paragraph.
   3. Equipment identification acronym as used on the drawings.
   4. The submittal date.
   5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
   6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer’s designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide shop drawings prepared in accordance with referenced standards identified as "Working Plans", including hydraulic calculations where applicable. Shop drawings shall be signed and sealed by a Professional Engineer registered in the state in which the project is located where required by local authorities having jurisdiction, or NICET Level III or IV certified technician.

Submit copies of the certification for the designer with submittal. Shop drawings consisting of the following shall be furnished at a minimum. Refer to NFPA 13 for additional requirements.

1. Scaled site plan indicating underground piping with sizes and hydrants utilized for flow test in relation to the building.
2. Layout drawings of complete fire sprinkler system indicating relationship to all other trades. This shall include all equipment, piping and a reflected ceiling plan indicating sprinkler locations.
3. Complete details and sections as required to clearly define and clarify the design indicated.
4. Shop drawings shall be to a standard scale and not less than 3/32" = 1'-0".
5. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
6. Hydraulic calculations shall be based on a water flow test conducted at the site within twelve (12) months of the submittal of plans for approval. The contractor shall be responsible for obtaining the flow test if existing data is not available. Flow test information shall be documented on shop drawings with an accompanying site plan to scale. Contractor shall verify with AHJ any minimum safety factor requirements. Demand shall not be less than 5 psig below the supply at the demand point.
    a. Hydrant testing shall be in accordance with NFPA 13 and 291 requirements.
7. Available fire-hydrant flow test record is located on F300 under Water Supply Information.

M. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval. Shop drawings showing deviations from the design without prior approval will not be approved.

N. Provide welders' qualification certificates.

O. Provide Test Reports and Certificates including:
1. "Contractor's Material & Test Certificate for Aboveground Piping"
2. "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA
    a. Underground piping test certificate shall be obtained prior to connection of the above ground system.

1.08 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.09 SUBSTITUTIONS

A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:
   1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
   2. The burden of proof of the merit of the proposed substitution is upon the proposer.
   3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
      a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
      b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
      c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
      d. Same warranty will be furnished for proposed substitution as for specified Work.
      e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
      f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:
   1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
   2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
   3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
   4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion for the project, furnish to the Architect, for Engineer's review, and for Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Include the following sections with the appropriate information for each section:
   1. Typewritten Index.
   2. Qualifications. Provide designer and installer qualification.
   3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
   4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
   5. Product Data: Provide product cut-sheets for all equipment utilized and installed.
   6. Guarantee. Copy of all guarantees and warranties issued.
   7. Testing/Certification: Provide all completed testing and certification forms as required per NFPA 13 and 25.
   8. Contact list with minimum three service representative phone numbers.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 21 specifications.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

D. The fire shop drawings and all information contained therein shall be utilized as the basis for the Record Drawings.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in a format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Fire Suppression Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided, and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Furnish service and maintenance of fire protection system for one year from date of substantial completion.

C. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

D. The following additional items shall be guaranteed:
   1. Piping shall be free from obstructions, holes or breaks of any nature.
   2. Proper sloping of pipe to drain in each piping system per NFPA 13.

E. The above guarantees shall include labor (including travel expenses), troubleshooting and material; and repairs or replacements shall be made without additional cost to the Owner.

F. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

G. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one-year guarantee period, each warranty instrument being addressed and stating the commencement date and term.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Electrical Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Fire Suppression Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Fire Suppression Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections.

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

D. Refer to Division 28, "Fire Detection and Alarm" for specification of sprinkler monitoring equipment connections.

E. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA codes.

F. System Pressures: All system components shall be listed for the actual designed system pressures.
   1. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall install, and test all new equipment identified in this contract and revise existing equipment as noted.

B. Installation shall be in accordance with NFPA requirements and the Contractor shall have employed or enlist the design services of at least one minimum NICET Level II certified technician.

C. Installer: Company specializing in the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire sprinkler submittal proof of factory training for each installer.

D. The Contractor shall provide all required equipment, sprinklers and piping for a complete and operational fire protection system. All components shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

E. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

3.02 PERMITS

A. Secure and pay for permits required in connection with the installation of the Fire Suppression Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.03 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Section.

B. Report test results promptly and in writing.

3.04 EXCAVATION AND BACKFILLING

A. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

B. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

C. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

D. The Contractor shall erect barricades around excavations, for safety, and shall place an adequate number of amber lights on or near the work and shall keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.

E. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

F. Install sediment and erosion control measures in accordance with local codes and ordinances.

G. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

H. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

I. Trenching: Excavate trenches for Fire Suppression installations as follows:
   1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
   2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
   3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
   4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
   5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
      a. For pipes or equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tamped sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.

J. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

K. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
   1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
   2. Under building slabs, use drainage fill materials.
   3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
   4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
   5. Other areas, use excavated or borrowed materials.

L. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Inspection, testing, approval, and locations of underground utilities have been recorded.
   2. Removal of concrete formwork.
   3. Removal of shoring and bracing, and backfilling of voids.
   4. Removal of trash and debris.

M. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

N. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

O. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

P. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
   1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
      a. Areas under structures, building slabs, steps, and pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
      b. Areas under walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
      c. Other areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

Q. Subsidence: Where subsidence occurs at Fire Suppression installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.05 CUTTING AND PATCHING

A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.

B. No structural member shall be cut without permission from Architect and Structural Engineer.

C. Patch around openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.06 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Fire Suppression Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Fire Suppression Contractor shall clean material and equipment installed under the Fire Suppression Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.07 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days' notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, they shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 210010

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 210500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with Fire Suppression installations as follows:
   1. Access panels and doors in walls, ceilings, and floors for access to Fire Suppression materials and equipment.
   2. Miscellaneous metals for support of Fire Suppression materials and equipment.
   3. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Fire Suppression materials and equipment.
   4. Joint sealers for sealing around Fire Suppression materials and equipment.

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
   2. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
   3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
   4. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
   5. Division 21 Section 211100 “Fire Suppression Water Service Piping” for fire suppression piping starting 5 feet outside the building to within the building.
   6. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.02 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
   1. Provide UL Label on each fire-rated access door.

PART 2 PRODUCTS AND MATERIALS

2.01 ACCESS TO EQUIPMENT

A. Acceptable Manufacturers:
   1. Bar-Co., Inc.
   2. Elmdor Stoneman.
   3. JL Industries
   4. Jay R. Smith Mfg. Co.

5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:
1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Fire Suppression Piping and Equipment” for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
    a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
    a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
8. Locking Devices: Flush, screwdriver-operated cam locks.

2.02 FIRE SUPPRESSION EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Fire Suppression equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.03 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.04 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
   1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.
   1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

2.05 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:
   1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
      a. "Dow Corning 790," Dow Corning Corp.
      b. "Silglaze II SCS 2801," General Electric Co.
      c. "Silpruf SCS 2000," General Electric Co.
      d. "864," Pecora Corp.
      e. "Rhodia 5C," Rhone-Poulenc, Inc.
      f. "Spectrem 1," Tremco, Inc.
      g. "Spectrem 2," Tremco, Inc.
      h. "Dow Corning 795," Dow Corning Corp.
      i. "Rhodia 7B," Rhone-Poulenc, Inc.
      j. "Rhodia 7S," Rhone-Poulenc, Inc.
      k. "Omniseal," Sonneborn Building Products Div.
   2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
      a. "Dow Corning 786," Dow Corning Corp.
      b. "Sanitary 1700," General Electric Co.
      c. "898 Silicone Sanitary Sealant," Pecora Corp.
      d. "OmniPlus," Sonneborn Building Products Div.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "Chem-Calk 600," Bostik Construction Products Div.
   b. "AC-20," Pecora Corp.
   c. "Sonolac," Sonneborn Building Products Div.
   d. "Tremflex 834," Tremco, Inc.

2.06 ACOUSTICAL SEALANTS

A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.

B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

PART 3 EXECUTION

3.01 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.02 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.03 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.

B. Select fastener sizes that will not 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 members.

C. Attach to substrates as required to support applied loads.

3.04 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.05 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
   2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.06 PENETRATIONS:

A. New Construction:
   1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping penetrations.

B. Construction in Existing Facilities:
   1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

I. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

J. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 21 Section “Basic Fire Suppression Piping Materials and Methods

END OF SECTION 210500

SECTION 210515
BASIC FIRE SUPPRESSION PIPING MATERIALS AND METHODS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section specifies piping materials and installation methods common to more than one Section of Division 21 and includes piping, joining materials, piping specialties and basic piping installation instructions.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
3. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
4. Division 21 Section 211100 “Fire Suppression Water Service Piping” for fire suppression piping starting 5 feet outside the building to within the building.
5. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.

1.02 SUBMITTALS

A. Refer to Division 1 and Division 21 “General Fire Suppression Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:
1. Piping and Fittings
2. Escutcheons
3. Dielectric Unions and Fittings
4. Sleeves and Mechanical Sleeve Seals
5. Wall Pipes

1.03 QUALITY ASSURANCE

A. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

B. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.

C. UL Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, for fire service.

D. Pipe, piping specialties and fittings shall be manufactured in plants located in the United States.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL REQUIREMENTS

A. All fire suppression system materials and components essential to successful system operation shall be listed for their intended purpose.

B. General: Refer to the individual piping system specification sections in Division 21 for specifications on piping and fittings relative to that particular system.

2.02 STEEL PIPE AND FITTINGS

A. All piping 2-inch and smaller:
   1. With the use of welded or roll grooved fittings: ASTM A135 or 795, Grade A, Schedule 10 or 40, seamless or ERW, black steel pipe.
   2. With the use of threaded fittings: ASTM A135 or 795, Grade A, Schedule 40, seamless or ERW, black steel pipe. All 1-inch piping shall have threaded ends.

B. All piping 2-1/2" and larger: ASTM A135 or 795, Grade A, Schedule 10, ERW, black steel pipe, roll grooved ends.

C. Piping used in dry pipe sprinkler systems shall be ASTM A135 or 795, Type E, Grade A, Schedule 40, black steel pipe, threaded or roll grooved ends.

   Galvanized piping including fittings is not permitted.

D. All piping on the exterior or interior corrosive environment of the building shall be painted red or as selected by Architect in color by one of the following methods;
   1. Field painted using urethane alkyd paint.
   2. Powder coated.
   3. Polymer enhanced coated.
   4. Galvanized and painted where within 1 to 5 miles of the coast.
   5. Galvanized and painted where in interior corrosive environment.

E. Acceptable alternatives to Schedule 40 and Schedule 10 pipe shall be manufactured to standards recognized by NFPA 13. Threaded pipe shall have a corrosion resistance rating (CRR) of 1.0 or greater. Crimp type couplings shall not be used. Threadable thinwall pipe with CRR less than 1.0 not permitted.

F. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

G. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

H. Steel Couplings: ASTM A 865, threaded

I. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

J. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

K. Malleable- or Ductile-Iron Unions: UL 860.

L. Cast-Iron Flanges: ASME 16.1, Class 125.

M. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

N. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

O. Grooved-Joint, Steel-Pipe Appurtenances
1. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
3. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
1. Valves shall be UL listed.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Check Valves:
1. Description: Swing-check type, rubber-face checks unless otherwise indicated, and ends matching piping.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:
1. Description: Bronze body and bonnet and bronze stem.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded or grooved.

D. Iron OS&Y Gate Valves:
   1. Description: Iron body and bonnet and bronze seating material.
   2. Standard: UL 262.
   3. Pressure Rating: 250 psig minimum.
   4. Body Material: Cast or ductile iron.
   5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:
   1. Standard: UL 1091.
   2. Pressure Rating: 175 psig minimum.
   3. Valves NPS 2 and Smaller:
      a. Valve Type: Ball or butterfly.
      b. Body Material: Bronze.
      c. End Connections: Threaded or grooved.
   4. Valves NPS 2-1/2 and Larger:
      a. Valve Type: Butterfly.
      b. Body Material: Cast or ductile iron.
      c. End Connections: Flanged or grooved.
   5. Valve Operation: Integral, prewired supervisory switch and visual indicating device.

2.05 TRIM AND DRAIN VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing.
   2. Pressure Rating: 175 psig minimum.

B. Automatic (Ball Drip) Drain Valves:
   1. Standard: UL 1726.
   2. Pressure Rating: 175 psig minimum.
   3. Type: Automatic draining, ball check.
   4. Size: NPS 3/4.
   5. End Connections: Threaded.

2.06 AUTOMATIC AIR RELEASE VALVE

A. Standard: UL 2573

B. Pressure Rating: 175 psig minimum.

2.07 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:
   1. Standard: UL 405.
   2. Type: Exposed, projecting, for wall mounting.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Corrosion-resistant metal.
   5. Inlets: NPS 2-1/2 brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

6. Caps: Brass, lugged type, with gasket and chain.
7. Escutcheon Plate: Round, brass, wall type.
8. Outlet: Back, with pipe threads, NPS 4”
9. Number of Inlets: Two.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR"
11. Finish: Rough brass or bronze.

2.08 PIPING SPECIALTIES

A. Escutcheons: Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
   1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
   2. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
   3. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
   4. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

B. Floor Plates: Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
   1. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
   2. Split-Casting Floor Plates: Cast brass with concealed hinge.

C. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

D. Dielectric Unions and Fittings: Provide factory-fabricated dielectric unions and fittings with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

E. Pressure Gauges
   1. Standard: UL 393.
   2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
   3. Pressure Gage Range: 0 to 300 psig.
   4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
   5. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

2.09 PENETRATIONS

A. Sleeves:
   1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
   2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
   3. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50

inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

4. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

B. Wall Pipes
   1. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with setscrews.

C. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
   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.
      a. Pressure Plates: Carbon steel or stainless steel.
      b. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

C. Painting of the sprinkler piping.
   1. Field painting of fire sprinkler piping per manufacturer’s published instructions and include a minimum of one-coat of rust inhibited primer and two-coats of urethane alkyd.
   2. Polymer enhanced coating per manufacturer’s published instructions.

3.02 PIPING INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal (minimum 6” clearance).

C. Install system such that all piping is rigidly secured and supported. All ductwork, lights, structural members and main runs of piping shall take precedence over sprinkler piping. Cutting of

structural members for passage of sprinkler pipes or hangers shall not be permitted. All horizontal piping in ceiling space shall be at an elevation above the top of light fixtures and air outlets to allow for access to light fixtures and air outlets without removing horizontal piping. Route all sprinkler piping and provide all offsets, bends, and elbows around all mechanical, electrical, and structural members as required.

D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.

E. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

F. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

I. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.

J. Coordinate pipe routing near electrical equipment in accordance with NFPA 70.

K. Verify final equipment locations for roughing in.

L. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."

M. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors.

3.03 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

C. Install unions in pipes NPS 2 and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.

D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

G. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads and Pipe Fitter's Handbook. Join pipe, fittings, and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   2. Align threads at point of assembly.
   3. Apply appropriate tape or thread compound to the external pipe threads.
   4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
   5. Damaged Threads: Do not use pipe with threads that are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9. Align flanged surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

I. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Joints for other piping materials are specified within the respective piping system sections.

3.04 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connection.

B. Install connections between 18- and 36-inches above finished grade and as indicated on the Drawings.

C. Grout or caulk pipe penetration in exterior wall.

D. Provide minimum 36-inch working clearance around connection for fire department access.

E. Install automatic (ball drip) drain valve at each check valve for fire department connection. The drain line shall discharge to the exterior.

3.05 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision.

B. Supervisory Switches: Supervise valves in open position unless noted otherwise.
   1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
   2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Water-Flow Indicators: Install in fire suppression piping where indicated. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

D. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.06 PIPING PROTECTION

A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at the end of each day or whenever work stops.

3.07 PENETRATIONS

A. Fire suppression penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.

B. Above Grade Concrete or Masonry Penetrations
   1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
      a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
      b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
      c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
         1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
         2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
      d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
   2. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

C. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
   1. Use type and number of sealing elements recommended by manufacturer 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.
   2. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

D. Elevated Floor Penetrations of Waterproof Membrane:
   1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1” above finish floor. Size wall pipe for minimum ½” annular space between pipe and wall pipe.
   2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1” annular clear space between inside of sleeve and outside of insulation.
   3. Pack with mineral wool and seal both ends with minimum of ½” of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
   4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
   5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.

F. Concrete Slab on Grade Penetrations:
   1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
   2. Provide 1/2-inch thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2-inch above and below the concrete slab.

G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of sealant. Refer to Division 21 Section "Common Work Results for Fire Suppression" for materials and installation.
   1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.

H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
   1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.

I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer’s UL listing. Refer to Division 21 Section “Common Work Results for Fire Suppression” for firestopping and materials.

3.08 ACOUSTICAL PENETRATIONS

A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the Fire Suppression equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Fire Sprinkler Piping
   1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

3.09 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections

END OF SECTION 210515

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SECTION 210548
SEISMIC CONTROLS FOR FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 20 Section “Seismic Controls for MEP/F/T Systems” for general requirement and related documents that apply to this section.

1.03 DEFINITIONS

A. The CBC: California Building Code.

B. ICC-ES: International Code Council Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUMMARY

A. Seismic bracing, restraints, and controls for all fire protection systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 PRODUCTS AND MATERIALS
(Not Used)

PART 3 EXECUTION
(Not Used)

END OF SECTION 210548

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SECTION 210553
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Extent of Fire Suppression work to be identified as required by this Section is indicated on drawings and/or specified in other Division 21 Sections.

B. Types of identification devices specified in this Section include the following:
   1. Equipment labels.
   2. Valve tags.
   3. Hydraulic placards.

C. Related Sections
   1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
   2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
   3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
   4. Division 21 Section 211100 "Fire Suppression Water Service Piping," for fire suppression piping starting 5 feet outside the building to within the building.
   5. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.

1.02 CODES AND STANDARDS:

A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

PART 2 PRODUCTS AND MATERIALS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, aluminum, or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
   2. Background/Letter Color: Red/White or Bare Metal/Black.
   3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for

greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, with predrilled holes for attachment hardware.
2. Background/Letter Color: Red/White
3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number,

2.02 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, stainless steel, aluminum or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain or S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

2.03 HYDRAULIC PLACARDS

A. Provide hydraulic calculation placard attached to each riser in accordance with NFPA 13. Placard shall include location of design area or areas, discharge densities over the design area or areas, required flow and pressures at the base of riser, occupancy classification and maximum permitted storage height and configuration, hose stream allowance included in addition to the sprinkler demand and name of installing contractor. Information shall be permanently and clearly displayed on placard.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT IDENTIFICATION

A. General: Install metal or plastic equipment marker on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Backflow Preventers

3.03 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire suppression systems

3.04 LABEL INSTALLATION

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 or permanently fasten labels on each major piece of equipment.

D. Locate equipment labels where accessible and visible.

END OF SECTION 210553

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SECTION 211100
FIRE SUPPRESSION WATER SERVICE PIPING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. The extent of this fire suppression water service piping shall be as specified herein. Contractor shall be responsible for preparation of design drawings, fabrication and installation for complete fire suppression water service piping for the building.

B. This section specifies:
   1. Materials and equipment for fire suppression water service piping and related components starting 5-feet outside the building and the following:
      a. Service entrance piping through floor into the building.

C. This section includes:
   1. Pipe and fittings
   2. Valves
   3. Backflow preventers
   4. Alarm devices
   5. Accessories

D. Provide facility fire suppression water service piping during construction in accordance with code.

E. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 21 Specifications Sections apply to this section.

F. Related Sections:
   1. Division 31 Section "Earthwork," for trenching and backfilling materials and methods for underground piping installations.
   2. Division 33 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building and extending to the water service line.
   3. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
   4. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
   5. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
   6. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
   7. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.02 SUBMITTALS

A. Submit shop drawings prepared in accordance with Division 21 Section 210010 “General Fire Suppression Requirements.”

1.03 QUALITY ASSURANCE

A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of the Facility Fire Suppression Water Service Piping.

B. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for fire suppression water service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. NFPA 24, “Private Fire Service Mains and their Appurtenances”, Latest Edition. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire suppression water service piping.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general piping fittings and piping specialty requirements.

2.02 DUCTILE-IRON PIPE AND FITTINGS.

A. Mechanical-Joint, Cement Lined Ductile-Iron Pipe: AWWA C151/C104, with mechanical-joint bell and plain spigot end.

B. Mechanical-Joint, Cement Lined Ductile-Iron Fittings: AWWA C110/C104, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Flanges: ASME B16.1, Class 125, cast iron.

D. Ductile-Iron Deflection Fittings:
   1. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   2. Pressure Rating: 250 psig minimum.

2.03 SERVICE ENTRANCE ASSEMBLY

A. At Contractor’s option, the service entrance is permitted to utilize a one-piece riser assembly to enter the building.
   1. Assembly shall be Ames Fire and Waterworks Series IBR or approved equivalent. In-Building Riser shall be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a grooved-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. The grooved end shall include a coupler and cap to facilitate testing of the underground piping.

2.04 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) or High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

2.05 CURB VALVES

A. Curb Valves: Comply with AWWA C800 for high pressure service line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.

B. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
   1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

C. Meter Valves: Comply with AWWA C800 for high pressure service line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.06 GATE VALVES

A. UL Listed Gate Valves:
   1. UL listed, Iron, Non-rising Stem Gate Valves:
      a. Description: Iron body and bonnet, bronze seating material, and inside screw.
      b. Standards: UL 262 listing.
      c. Pressure Rating: 175 psig minimum.
      d. End Connections: Mechanical or push-on joint.
      e. Indicator-Post Flange: Include on valves used with indicator posts.
   2. UL-Listed, Iron, OS&Y, Gate Valves:
      a. Description: Iron body and bonnet and bronze seating material.
      b. Standards: UL 262 listing.
      c. Pressure Rating: 175 psig minimum.
      d. End Connections: Flanged or grooved.

2.07 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5-inches (125 mm) in diameter.
   1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Indicator Posts:
   1. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
   2. Standards: UL 789 listing.

2.08 CHECK VALVES

A. UL listed Check Valves:
   1. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
   2. Standards: UL 312 listing.
   3. Pressure Rating: 175 psig minimum.

2.09 BACKFLOW PREVENTERS

A. Double Check Backflow Preventer Assembly:
   1. Standard: ASSE 1015.
   2. Operation: Continuous-pressure applications unless otherwise indicated.
   3. Body Material: Cast iron with fused epoxy coating or stainless steel.
   4. End Connections: Threaded, flanged or grooved.
   5. Accessories: Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.

PART 3 EXECUTION

3.01 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.02 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated elevation.

C. Pipe Beds:
   1. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. Provide first layer of pea gravel backfill 6-inch above pipe, tamp backfill with mechanical tamper to 85% to 95% compaction. For piping with rock trench bottoms, provide sand pipe bed 6-inch underneath and around sides of pipe up to middle half of the pipe, including fittings.

D. Provide backfill above top of pipe bed as required for field conditions. Refer to Division 21 Section 210010 "General Fire Suppression Requirements" for materials and methods for backfill.

3.03 PIPE APPLICATIONS

A. Piping below grade: Provide cement lined ductile iron pipe and fittings with mechanical joints.

3.04 PIPING INSTALLATION

A. Comply with NFPA 24 for fire service main piping materials and installation.

B. Water main connection: Arrange with water utility company for tap of size and in location indicated in water main or tap water main according to the requirements of the water utility company.

C. Install ductile-iron, water service piping according to AWWA C600 and AWWA M41.
   1. Install encasement for piping according to ASTM A 674 or AWWA C105.

D. Bury piping with depth of cover over top of piping at least 30-inches, with top at least 12-inches below level of maximum frost penetration, and according to the following:
   1. Under Driveways: With at least 36-inches of cover over top.
   2. Under Railroad Tracks: With at least 48-inches of cover over top.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Extend fire suppression water service piping and connect to water supply source and building fire suppression water service piping systems at locations and pipe sizes indicated.
   1. Terminate fire suppression water service piping at building floor slab until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire suppression water service piping systems when those systems are installed.

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

H. Comply with requirements in Section 211313 "Water-Based Fire Suppression Systems," for fire suppression water piping inside the building.

I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."

J. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."

K. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.

3.05 JOINT CONSTRUCTION

A. See Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general joint construction requirements.

B. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

C. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

D. Ductile-Iron Piping, Gasketed-Joints for Fire Service Main Piping: UL 194.

E. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

3.06 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Locking mechanical joints.
   2. Bolted flanged joints.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire suppression water service piping according to NFPA 24 and the following:
   1. Gasketed-Joint, Ductile-Iron, Water Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.07 VALVE INSTALLATION

A. See Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general valve installation requirements.

B. UL-Listed Valves Other Than Gate Valves: Comply with NFPA 24.

C. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03.

3.08 BACKFLOW PREVENTER INSTALLATIONS

A. Install backflow preventer at each fire protection entry in compliance with the plumbing code and Authority Having Jurisdiction. Locate in an accessible and testable location.
   1. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain or exterior.

B. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks.

C. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

D. Do not install bypass piping around backflow preventers.

E. Support NPS 2-1/2 and larger backflow preventers with pipe supports attached to the floor with anchor bolts where indicated on the drawings.

F. Test backflow preventer per requirements of plumbing or division of cross connection control official.
   1. Reports: Prepare backflow preventer test reports signed by the plumbing or division of cross connection control official and turn over to the Architect upon completion of the project.

3.09 FIELD QUALITY CONTROL

A. Flush, test, and inspect in accordance with NFPA 24.

B. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.

C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

3.10 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground fire suppression water service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.11 CLEANING

A. Clean fire suppression water service piping as follows:
   1. Flush new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use flushing procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

B. Prepare reports of flushing activities.

END OF SECTION 211100

SECTION 211313
WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. The extent of this fire sprinkler system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete fire sprinkler protection for the building.

B. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire protection valves.
3. Sprinkler pipe fittings.
4. Sprinklers.
5. Alarm devices.

C. Related Sections:
1. Division 21 Section 210010 “General Fire Suppression Requirements” for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
4. Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment” for labeling and identification of installed fire suppression equipment.
5. Division 21 Section 211100 “Fire Suppression Water Service Piping” for fire suppression piping starting 5 feet outside the building to within the building.

1.02 SYSTEM DESCRIPTION

A. Fire protection system in the location or portion of the building is a Wet Pipe and Dry Pipe system.
1. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to a water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts a fusible link or destroys a frangible device. Hose connections are included if indicated.
2. Dry Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open a dry pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Provide system(s) as specified herein and as shown on drawings. The sprinkler system shall be supplied by the underground as shown on the Drawings.

C. Provide dry pipe fire protection system for non-heated spaces and other areas of building subject to freezing including the loading docks and canopies, mansards, and balconies. Portions of

systems subject to freezing or temperatures below 40° F shall be protected against freezing as required by NFPA 13. The Contractor shall be responsible for repairs and for all costs incurred from damage caused by freezing of the fire protection system.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design fire suppression system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Standard Pressure, Fire Suppression System Component: Listed for 175-psig minimum working pressure.

C. Performance Criteria: Refer to Protection Criteria Legend on sheet F300.
   1. Design Criteria for Automatic-Sprinkler Piping Design:
      a. Light Hazard Occupancy:
         1) Minimum Design Density: 0.10 gpm over 1,500 sq.ft. area.
         2) Maximum protection area per sprinkler: 225 sq.ft.
         3) Minimum Combined Hose Stream Demand Requirement: 100 gpm for 30 minutes.
      b. Ordinary Hazard Group 1 Occupancy:
         1) Minimum Design Density: 0.15 gpm over 1,500 sq.ft. area.
         2) Maximum area per sprinkler: 130 sq.ft..
         3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
      c. Ordinary Hazard Group 2 Occupancy:
         1) Minimum Design Density: 0.20 gpm over 1,500 sq.ft. area.
         2) Maximum protection area per sprinkler: 130 sq.ft.
         3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
      d. Exterior Canopy - Ordinary Hazard Group 2 Occupancy:
         1) Minimum Design Density: 0.20 gpm over 1950 sq.ft. area.
         2) Maximum protection area per sprinkler: 130 sq.ft.
         3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.

D. The criteria listed herein shall not preclude the use of extended coverage or special application fire sprinklers designed and installed in accordance with their listing and manufacturer's instructions.

E. The hydraulic area of operation may not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers in unfinished shell spaces. For all other areas, the hydraulic area of operation shall not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers unless specifically approved by the Engineer via a formally submitted RFI.

F. Sprinkler spacing shall conform to NFPA 13 and shall not exceed 256 SF per sprinkler in unfinished shell spaces.

G. The hydraulic area of operation shall be increased by 30% without revising the density for areas with sloped ceilings with a pitch exceeding 1 in 6 (16.7% slope) in accordance with NFPA 13.

H. The hydraulic area of operation shall be increased by 30% without revising the density for dry-pipe systems in accordance with NFPA 13.

1.04 SUBMITTALS

A. Submit shop drawings prepared in accordance with NFPA 13 as specified in Division 21 Section 210010 "General Fire Suppression Requirements."

1.05 QUALITY ASSURANCE

A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire sprinkler system.

B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.

1.06 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.07 EXTRA MATERIALS

A. Sprinkler Wrenches: Furnish to Owner, 2 sprinkler wrenches for each type of sprinkler installed.

B. Sprinklers: Furnish extra sprinklers of each style, type and finish included in the project as required by NFPA 13.

C. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet(s), suitable for wall mounting, with hinged cover and space for the quantity of spare sprinklers provided plus sprinkler wrench(es).

D. Provide hydraulic calculation placard attached to each riser.

PART 2 PRODUCTS AND MATERIALS

2.01 EQUIPMENT

A. All fire protection equipment shall be UL listed for its intended use and in conformance with the applicable NFPA documents.

2.02 PIPE AND FITTING MATERIALS

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for specifications on piping and fittings.

2.03 HANGERS

A. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.

2.04 GENERAL DUTY VALVES

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for specifications on general duty valves.

2.05 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing.
   2. Pressure Rating:
      a. Standard Pressure Piping Specialty Valves: 175-psig minimum.
   3. Body Material: Cast- or ductile- iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
   1. Standard: UL 260.
   2. Design: Differential-pressure type.
   3. Include UL 1486, quick-opening devices, trim sets for bypass, air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, drip cup assembly piped with check valve to main drain piping, priming chamber attachment, and fill-line attachment with strainer.
   4. Air-Pressure Maintenance Device:
      a. Type: Automatic device to maintain minimum air pressure in piping.
      b. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
   5. Air Compressor:
      a. Type: Oil-less, air-cooled
      b. Standard: UL's "Fire Protection Equipment Directory" listing.
      c. Motor Horsepower: Fractional.
      d. Power: 120-V ac, 60 Hz, single phase, hard wired per NEC and manufacturer’s requirements.
      e. Provide combination fused disconnect switch and magnetic starter.

C. Air Release Valve:
   1. Provide for all wet pipe sprinkler systems utilizing metallic piping in accordance with one of the following options:
      a. Manual ball valve with a minimum size of ½ inch (15 mm).
      b. Listed and/or Factory Mutual Approved automatic valve.

2.06 PIPE FITTINGS

A. Branch Outlet Fittings:
   1. Standard: UL 213.
   2. Pressure Rating: 175-psig minimum.
   3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   4. Type: Mechanical-T and -cross fittings.

5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, welded or threaded.

B. Flow Detection and Test Assemblies:
1. Standard: UL's "Fire Protection Equipment Directory" listing.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Grooved or threaded.

C. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" listing.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Flexible Piping Systems:
1. At Contractor’s option, UL listed and FM approved flexible piping connections to sprinklers may be used for both acoustical panel and gypsum board ceilings when suitable for their intended use. Piping shall be seismically qualified per ICC-ES AC-156 where required.
2. Description: Connections shall include a leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1 inch.
3. Flexible piping lengths shall not exceed 6 feet.
4. Installation shall not exceed the minimum bend radius and maximum allowable bends as specified by the manufacturer.
5. Change in direction shall be gradual enough to allow flexible piping to bend without crimping, distorting or reducing internal diameter.

2.07 AUTOMATIC SPRINKLERS

A. Sprinklers: type and style as indicated or required by application. Sprinkler operating temperatures to comply with NFPA 13. Sprinklers in Light Hazard areas shall be quick response type.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing.
2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Use sprinkler types below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Recessed sprinklers.
   3. Rooms with Gypsum Board Ceilings: Recessed sprinklers.
   4. Wall Mounting: Sidewall sprinklers.
   5. Spaces Subject to Freezing: Dry pendent or dry sidewall sprinklers as indicated on drawings.

E. Provide sprinkler types below with finishes indicated.
   1. Finished Areas:
      a. Recessed Sprinklers: white painted with white escutcheon.
      b. Upright, Pendent, and Sidewall Sprinklers: white painted with white escutcheon.
      c. Unfinished Areas: Rough bronze in unfinished spaces not exposed to view.

F. Coordinate sprinkler temperature ratings near heat-producing sources in accordance with NFPA 13.

G. Sprinklers shall be wax coated where exposed to acids, chemicals, or other corrosive fumes.

H. Sprinkler Guards: Provide sprinkler guard where sprinklers are less than 7-feet above finished floor; where subject to physical damage, and/or where indicated on drawings. Guard shall be UL 199 listed, wire cage type with fastening device for attaching to sprinkler.

I. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet, suitable for wall mounting, with hinged cover and space for the appropriate quantity of spare sprinklers plus sprinkler wrench(es).

2.08 ALARM DEVICES

A. General: Alarm device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
   1. Standard: UL 464.
   2. Type: Vibrating, metal alarm bell.
   3. Size: 6-inch minimum diameter.
   4. Finish: Red-enamel factory finish, suitable for outdoor use.
   5. Provide engraved lamacoid plate under bell lettered “Building Fire Sprinkler System.”

C. Water Flow Indicators:
   1. Standard: UL 346.
   2. Water-Flow Detector: Electrically supervised.
   3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field-adjustable retard element to prevent false signals and tamperproof cover.
   4. Type: Paddle operated.
   5. Pressure Rating: 250 psig.
   6. Design Installation: Horizontal or vertical.

D. Pressure Switches – Water Flow Alarm Detection:
   1. Standard: UL 346.

2. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field adjustable retard element to prevent false signals and tamperproof cover.
3. Type: Electrically supervised water flow switch with retard feature.
4. Pressure Rating: 250 psig.
5. Design Operation: Rising pressure signals water flow.

E. Pressure Switches – Low/High Air Pressure Supervisory:
1. Standard: UL 346.
2. Components: Two single-pole, double-throw circuit switches for isolated alarm contacts, 7 A, 125-V ac and 0.25 A, 24-V dc.
3. Type: Electrically supervised pressure supervisory switch
4. Pressure Rating: 250 psig.
5. Design Operation: Rising pressure signals excessive supervisory air pressure within the system piping, with lowering pressure signals lack of air pressure within the system piping.

F. Valve Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled valve is in other than fully open position.

G. Indicator Post Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled indicator post valve is in other than fully open position.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

3.02 PREPARATION

A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

3.03 WATER SUPPLY CONNECTION

A. Connect sprinkler piping to water service piping for service entrance to building. Do not connect to underground supply until provided with written documentation that piping has been flushed and pressure tested in accordance with NFPA 13. Comply with requirements for exterior piping in Division 21 Section 211100 “Fire Suppression Water Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section 211100 “Fire Suppression Water Service Piping."

C. Wet pipe systems shall be equipped with a listed relief valve not less than ½-inch in size and set to operate at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.

3.04 PIPE APPLICATIONS

A. Piping Below Grade: Refer to Division 21 Section 211100 “Fire Suppression Water Service Piping.”

B. Piping Above Grade: Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods.”

3.05 PIPING INSTALLATIONS

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general fire suppression piping installation requirements.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13. Locate hangers at or directly adjacent to the joist panel points. Provide two nuts on threaded supports to securely fasten the support.

D. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.

E. Install pressure gauge on the riser or feed main at or near each test connection. Provide pressure gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they will not be subject to freezing.

F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

G. Fill wet-type sprinkler system piping with water.

H. Connect compressed air supply to dry pipe sprinkler piping.

I. Connect air compressor to the following piping and wiring:
   1. Pressure gauges and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including high- and low-pressure alarm.

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods"

K. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

3.06 PIPE JOINT CONSTRUCTION

A. Refer to Division 21 Section 210515 “Basic Fire Suppression Piping Materials and Methods” for general pipe joint construction requirements.

3.07 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable water supply sources.

3.08 SPRINKLER INSTALLATIONS

A. Use proper tools to prevent damage during installations.

B. Areas with ceilings: Install sprinklers not less than 6-inches from the edge of a ceiling tile in areas with suspended ceilings, in a symmetrical pattern with lights and outlets.

C. Install sprinklers in a symmetrical pattern with lights and outlets in all other areas with ceilings.

D. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

E. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

F. Do not install more than one sprinkler on a one inch outlet unless hydraulic calculations are included to verify performance.

3.09 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 21 Section 210553 “Identification for Fire Suppression Piping and Equipment.”

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform required tests and inspections.

B. Tests and Inspections:
   1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Flush, test, and inspect sprinkler systems according to NFPA 13, “Systems Acceptance” Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire department equipment.

C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 COMMISSIONING

A. Sprinkler Systems: Test per NFPA 13, NFPA 25 and local authorities’ requirements. Submit Contractor’s Material & Test Certificates for Above Ground Piping. Submit certificates of completion to Authority Having Jurisdiction and Owner.
   1. After completion of all installation, tests, etc., and prior to the opening date, the Sprinkler Subcontractor shall instruct the building personnel in the operation of the sprinkler system. Special care shall be taken to make sure the building personnel:
      a. Will immediately recognize whether the system control valves are in an ‘Open’ position or a ‘Closed’ position.
      b. Will know how to drain the system.
      c. Will know how to test the flow switches, tamper switches and alarm system.
      d. Will know how to test the dry pipe valve.
      e. Will know how to make complete weekly inspection.
      f. Will know how to perform periodic maintenance of the Fire Sprinkler System.

B. Fire Alarm Equipment: Test per NFPA 25, NFPA 72 and local authorities’ requirements in the presence of the Owner. Submit certificates of completion to authority having jurisdiction and Owner.

END OF SECTION 211313

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DIVISION 22 - PLUMBING SPECIFICATION

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SECTION 220010
GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.02 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer’s requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.03 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

FBC	Florida Building Code – 2023
FMC	Florida Mechanical Code – 2023
FPC	Florida Plumbing Code – 2023
IFGC	International Fuel Gas Code – 2023
IECC	International Energy Conservation Code – 2023
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Airc Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.04 DEFINITIONS

A. General:
   1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
   2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
   3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
   4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
   5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
   6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
   7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
   8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
      a. 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.
      b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
   9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”.

The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:
   1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
   2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
   3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
   4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
   5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
   6. Drainage Fill: as used in this Section refers to gravel installed to assist in the removal of underslab groundwater.
   7. Building Fill: as used in this section refers to borrowed fill material of rock 1” and larger used to fill foundation excavations.

1.05 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The Contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The Contractor shall inform the Architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The Contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

D. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to

the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.06 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.07 SUBMITTALS

A. Refer to Division 1 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples and other submittals required by this Division as noted in Table 1 at the end of this Section. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Plumbing construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:
   1. The project name.
   2. The applicable specification section and paragraph.
   3. Equipment identification acronym as used on the drawings.
   4. The submittal date.
   5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
   6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide welders' qualification certificates.

1.08 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.09 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:
   1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
   2. The burden of proof of the merit of the proposed substitution is upon the proposer.
   3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
      a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
      b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
      c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
      d. Same warranty will be furnished for proposed substitution as for specified Work.
      e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
      f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:
   1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
   2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
   3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
   4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in Table 5.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.

B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:
   1. Piping shall be free from obstructions, holes or breaks of any nature.
   2. Insulation shall be effective.
   3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.17 TEMPORARY FACILITIES

A. Refer to Division 1 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
   1. Water: Premises are supplied with water services which may be used in this work: Contractor shall make his own arrangements for water services.
   2. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
   3. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, nonclogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
   1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
   2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.18 PROJECT CONDITIONS

A. Conditions Affecting Work In Existing Buildings:
   1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting His bid to determine the nature and extent of work involved.
   2. Work in the existing building shall be scheduled with the Owner.
   3. Certain demolition work must be performed prior to the remodeling. The Plumbing Contractor shall perform the demolition which involves Plumbing and Plumbing systems, fixtures, equipment, piping, equipment supports or foundations and materials.
   4. Plumbing Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Plumbing Contractor during this demolition shall become his property and shall be removed by the Plumbing Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
   5. Plumbing Contractor shall relocate and reconnect Plumbing facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Plumbing equipment or materials are removed, the Plumbing Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
   6. General Contractor shall install finish material.
   7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
   8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   9. Locate, identify, and protect Plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 PRODUCTS AND MATERIALS

2.01 SOIL MATERIALS

A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).

B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

C. Drainage Fill: Provide washed, evenly graded mixture of ¾" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.

D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 EXECUTION

3.01 PERMITS

A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.02 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.03 SELECTIVE DEMOLITION

A. Refer to Division 01, Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.

B. General: Demolish, remove, demount, and disconnect abandoned Plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.

C. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing Plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

E. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures and insulation.
      a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
      b. Perform cutting and patching required for demolition in accordance with Division 1, General Conditions and "Cutting and Patching" portion of this Section in Division 22.

3.04 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
   1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
   2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for Plumbing installations as follows:
   1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
   2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
   3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
   4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
   5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

N. Bedding:

1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.

O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
5. Other areas, use excavated or borrowed materials.

P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.

R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

S. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

V. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.05 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

G. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.06 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.07 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
   1. Submit complete Operation and Maintenance Manuals.
   2. Submit complete Record Drawings.
   3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
   4. Start-up testing of systems.
   5. Removal of temporary facilities from the site.
   6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days' notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 220010

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	NONE
220515	Basic Piping Materials And Methods	B, G
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	NONE
220548	Seismic Controls For Plumbing Piping & Equipment	NONE
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	NONE
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221118	PEX Tubing and Specialties for RO and ROR Systems	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221400	Storm Drainage Piping & Specialties	B
221489	Sump Pumps	A, B, C, E
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N
227000	Natural Gas Systems	A, B, C, D, F, G
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H, N

CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder’s Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
220553	Identification For Plumbing Piping & Equipment	_____
221100	Water Distribution Piping & Specialties	_____
221111	Mechanically Joined Plumbing Piping Systems	_____
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	_____
221118	PEX Tubing and Specialties for RO and ROR Systems	_____
224000	Plumbing Fixtures	_____
221123	Domestic Water Pumps	_____
221510	Beverage System Bulk CO2 Systems	_____
[221329	Sanitary Sewerage Pumps	_____]
[221489	Sump Pumps	_____]
223100	Water Softeners	_____
223130	Copper Silver Ionization System	_____
223200	Domestic Water Filtration Equipment	_____
22610	Gas & Vacuum Systems For Medical Facilities	_____
226200	Gas & Vacuum Systems For Laboratories	_____
227000	Natural Gas Systems	_____

_____
Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
223100	Water Softeners	_____
22320	Domestic Water Filtration Equipment	_____
223300	Electric Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		COMPLETED/DATE/INITIAL
220540	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220500	Common Work Results For Plumbing	B
220515	Basic Piping Materials And Methods	B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221112	PEX Tubing for Water Distribution Systems UPONOR	A, B, F, H, I
221118	PEX Tubing and Specialties for RO and ROR Systems	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
224000	Plumbing Fixtures	B, E, H, I
227000	Natural Gas Systems	A, B, C, H
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H

CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____
_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples
☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____
_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____
_____
_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.

B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.

C. Proposed substitution does not affect dimensions and functional clearances.

D. Proposed substitution has received necessary approvals of authorities having jurisdiction.

E. Same warranty will be furnished for proposed substitution as for specified Work.

F. Same maintenance service and source of replacement parts, as applicable, is available.

G. Proposed substitution will not adversely affect other trades or delay construction schedule.

H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

_____	_____	_____
Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:
I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

_____	_____	_____
Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

_____	_____	_____
Contractor Acceptance Signature	Date	Company
_____	_____	_____
Owner Acceptance Signature	Date	Company
_____	_____	_____
Architect Acceptance Signature	Date	Company
_____	_____	_____
Engineer Acceptance Signature	Date	Company

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SECTION 220010
GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.02 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer’s requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.03 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

UBC	Uniform Building Code – 2___
UMC	Uniform Mechanical Code – 2___
UPC	Uniform Plumbing Code – 2___
UFGC	Uniform Fuel Gas Code – 2___
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Airc Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.04 DEFINITIONS

A. General:
   1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
   2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
   3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
   4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
   5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
   6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
   7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
   8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
      a. 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.
      b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
   9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
6. Drainage Fill: as used in this Section refers to gravel installed to assist in the removal of underslab groundwater.
7. Building Fill: as used in this section refers to borrowed fill material of rock 1” and larger used to fill foundation excavations.

1.05 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The Contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The Contractor shall inform the Architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The Contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

D. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.06 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.07 SUBMITTALS

A. Refer to Division 1 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples and other submittals required by this Division as noted in Table 1 at the end of this Section. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Plumbing construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available

space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:
   1. The project name.
   2. The applicable specification section and paragraph.
   3. Equipment identification acronym as used on the drawings.
   4. The submittal date.
   5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
   6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide welders' qualification certificates.

1.08 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.09 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:
   1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
   2. The burden of proof of the merit of the proposed substitution is upon the proposer.
   3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
      a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
      b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
      c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
      d. Same warranty will be furnished for proposed substitution as for specified Work.
      e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
      f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:
   1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
   2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
   3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
   4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in Table 5.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.

B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.12 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:
   1. Piping shall be free from obstructions, holes or breaks of any nature.
   2. Insulation shall be effective.
   3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.17 TEMPORARY FACILITIES

A. Refer to Division 1 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
   1. Water: Premises are supplied with water services which may be used in this work: Contractor shall make his own arrangements for water services.
   2. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
   3. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, nonclogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
   1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
   2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.18 PROJECT CONDITIONS

A. Conditions Affecting Work In Existing Buildings:

1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting His bid to determine the nature and extent of work involved.
2. Work in the existing building shall be scheduled with the Owner.
3. Certain demolition work must be performed prior to the remodeling. The Plumbing Contractor shall perform the demolition which involves Plumbing and Plumbing systems, fixtures, equipment, piping, equipment supports or foundations and materials.
4. Plumbing Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Plumbing Contractor during this demolition shall become his property and shall be removed by the Plumbing Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
5. Plumbing Contractor shall relocate and reconnect Plumbing facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Plumbing equipment or materials are removed, the Plumbing Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
6. General Contractor shall install finish material.
7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
9. Locate, identify, and protect Plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 PRODUCTS AND MATERIALS

2.01 SOIL MATERIALS

A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).

B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

C. Drainage Fill: Provide washed, evenly graded mixture of ¾" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.

D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 EXECUTION

3.01 PERMITS

A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.02 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.03 SELECTIVE DEMOLITION

A. Refer to Division 01, Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.

B. General: Demolish, remove, demount, and disconnect abandoned Plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.

C. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing Plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

E. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures and insulation.
      a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
      b. Perform cutting and patching required for demolition in accordance with Division 1, General Conditions and "Cutting and Patching" portion of this Section in Division 22.

3.04 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
   1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
   2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for Plumbing installations as follows:
   1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
   2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
   3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
   4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
   5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

N. Bedding:
1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.

O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
5. Other areas, use excavated or borrowed materials.

P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.

R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

S. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy

equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

V. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.05 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

G. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.06 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.07 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
   1. Submit complete Operation and Maintenance Manuals.
   2. Submit complete Record Drawings.
   3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
   4. Start-up testing of systems.
   5. Removal of temporary facilities from the site.
   6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days’ notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 220010

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	NONE
220515	Basic Piping Materials And Methods	B, G
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	NONE
220548	Seismic Controls For Plumbing Piping & Equipment	NONE
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	NONE
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221118	PEX Tubing and Specialties for RO and ROR Systems	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221400	Storm Drainage Piping & Specialties	B
221489	Sump Pumps	A, B, C, E
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N
227000	Natural Gas Systems	A, B, C, D, F, G
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H, N

CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder’s Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
220553	Identification For Plumbing Piping & Equipment	_____
221100	Water Distribution Piping & Specialties	_____
221111	Mechanically Joined Plumbing Piping Systems	_____
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	_____
221118	PEX Tubing and Specialties for RO and ROR Systems	_____
224000	Plumbing Fixtures	_____
221123	Domestic Water Pumps	_____
221510	Beverage System Bulk CO2 Systems	_____
[221329	Sanitary Sewerage Pumps	_____]
[221489	Sump Pumps	_____]
223100	Water Softeners	_____
223130	Copper Silver Ionization System	_____
223200	Domestic Water Filtration Equipment	_____
22610	Gas & Vacuum Systems For Medical Facilities	_____
226200	Gas & Vacuum Systems For Laboratories	_____
227000	Natural Gas Systems	_____

_____
Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
223100	Water Softeners	_____
22320	Domestic Water Filtration Equipment	_____
223300	Electric Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		COMPLETED/DATE/INITIAL
220540	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220500	Common Work Results For Plumbing	B
220515	Basic Piping Materials And Methods	B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221112	PEX Tubing for Water Distribution Systems UPONOR	A, B, F, H, I
221118	PEX Tubing and Specialties for RO and ROR Systems	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
224000	Plumbing Fixtures	B, E, H, I
227000	Natural Gas Systems	A, B, C, H
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H

CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.

I. Proposed substitution is consistent with the Contract Documents and will produce indicated results.

J. Proposed substitution does not affect dimensions and functional clearances.

K. Proposed substitution has received necessary approvals of authorities having jurisdiction.

L. Same warranty will be furnished for proposed substitution as for specified Work.

M. Same maintenance service and source of replacement parts, as applicable, is available.

N. Proposed substitution will not adversely affect other trades or delay construction schedule.

O. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

_____	_____	_____
Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

_____	_____	_____
Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance ☐ Yes ☐ No

Additional Comments: ☐ Attached ☐ None

Acceptance Section:

_____	_____	_____
Contractor Acceptance Signature	Date	Company

_____	_____	_____
Owner Acceptance Signature	Date	Company

_____	_____	_____
Architect Acceptance Signature	Date	Company
_____	_____	_____
Engineer Acceptance Signature	Date	Company

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SECTION 220015
COORDINATION

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.02 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.03 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

PART 3 EXECUTION

3.01 CONTRACTOR COORDINATION

A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches	DIV 22	DIV 22	DIV 26	DIV 23
Remote pressure switches (booster pumps)	DIV 22	DIV 22	---	DIV 23
Temperature control panels	DIV 22	DIV 22	DIV 26	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23
Motor and solenoid operated valves	DIV 22	DIV 22	DIV 23	DIV 23

DIV 22 = Plumbing Contractor
DIV 26 = Electrical Contractor
DIV 23 = Building Automation System Contractor, refer to Division 23 Section ”Direct-Digital Control for HVAC”.

END OF SECTION 220015

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SECTION 220500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:
   1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
   2. Plumbing equipment nameplate data.
   3. Concrete for bases and housekeeping pads.
   4. Non-shrink grout for equipment installations.
   5. Sleeves for Plumbing penetrations.
   6. Miscellaneous metals for support of Plumbing materials and equipment.
   7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
   8. Joint sealers for sealing around Plumbing materials and equipment.

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
   2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
   3. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for indirect drain piping and installation requirements.
   4. Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system of leak detection system “Water Present” alarm.
   5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
   6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Division 1 and Division 22 Section “General Plumbing Requirements”.
   1. Product data for the following products:
      a. Access panels and doors.
      b. Through and membrane-penetration firestopping systems.
      c. Joint sealers.
   2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.
   3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
   4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
   a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.03 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
   1. Provide UL Label on each fire-rated access door.

C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.04 NOISE CRITICAL SPACES

A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

Space	RC Levels
Sanctuary	25
Choir Risers	25
Stage	25
Sound/Lighting Control Rooms	25
A/V Spaces	25
TV Production Studio	25
Drama Theatres	25
Music Teaching Studios	25
Teleconference Rooms	25

Meeting/Banquet Rooms	30
Conference Rooms	30
Courtrooms	30

PART 2 PRODUCTS AND MATERIALS

2.01 ACCESS TO EQUIPMENT

A. Manufacturer:
   1. Bar-Co., Inc.
   2. Elmdor Stoneman.
   3. JL Industries
   4. Jay R. Smith Mfg. Co.
   5. Karp Associates, Inc.
   6. Milcor
   7. Nystrom Building Products
   8. Wade
   9. Zurn

B. Access Doors:
   1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Plumbing Piping” for labeling of access doors.
   2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
   3. Access doors must be of the proper construction for type of construction where installed.
   4. The exact location of all access doors shall be verified with the Architect prior to installation.
   5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
   6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
      a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
      b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
      c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
   7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
      a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
   8. Locking Devices: Flush, screwdriver-operated cam locks.
   9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.02 PLUMBING EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.03 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment.. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.

B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.

C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.

D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24” on center with a minimum of two bars each direction.

E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.

F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2”

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.04 GROUT

A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.

B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.

C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.05 PENETRATIONS

A. Sleeves:
   1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
   2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.06 DRIP PANS

A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2” lapped and soldered joints. Drip pan shall have a depth of 2” and a width of 6” in addition to the diameter of the associated pipe. Provide 3/4” galvanized pipe with male NPT outlet at low point of drip pan.

B. Drip pan supports shall be ¼” X 2” galvanized bar stock welded to the drip pan without holes.

2.07 LEAK DETECTION SYSTEM

A. Leak detection system with Rope style leak sensor and controller capable of connecting to a building automation system with audible and visual alarms for leak detection and cable failure in all drip pans unless otherwise noted on drawings. Provide with factory 24V DC power supply with power plug, sensing cables, and accessories.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. RLE Technologies #LD1000

2.08 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.09 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.10 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:
   1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
      a. "Dow Corning 790," Dow Corning Corp.
      b. "Silglaze II SCS 2801," General Electric Co.
      c. "Silpruf SCS 2000," General Electric Co.
      d. "864," Pecora Corp.
      e. "Rhodia 5C," Rhone-Poulenc, Inc.
      f. "Spectrem 1," Tremco, Inc.
      g. "Spectrem 2," Tremco, Inc.
      h. "Dow Corning 795," Dow Corning Corp.
      i. "Rhodia 7B," Rhone-Poulenc, Inc.
      j. "Rhodia 7S," Rhone-Poulenc, Inc.
      k. "Omniseal," Sonneborn Building Products Div.
   2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
      a. "Dow Corning 786," Dow Corning Corp.
      b. "Sanitary 1700," General Electric Co.
      c. "898 Silicone Sanitary Sealant," Pecora Corp.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:
   1. Products: Subject to compliance with requirements, provide one of the following:

a. "Chem-Calk 600," Bostik Construction Products Div.
b. "AC-20," Pecora Corp.
c. "Sonolac," Sonneborn Building Products Div.
d. "Tremflex 834," Tremco, Inc.

2.11 ACOUSTICAL SEALANTS

A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.

B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

2.12 PLENUM INSULATION

A. General: Combustible materials including, but not limited to, plastic pipe and plastic-coated cables that do not meet the minimum combustibility requirements of the applicable building codes may be installed in fire-rated return air plenums when enclosed within high-temperature insulation blanket where approved by the authority having jurisdiction.

B. Material: Light weight, high temperature inorganic fiber blanket enhanced for biosolubility and encapsulated with a scrim-reinforced foil.

C. Certification: Plenum insulation shall have an encapsulated flame spread rating less than 25 and a smoke developed rating of less than 50. The product shall be UL 1887 (Modified) listed, certified by ASTM E-136 for Non-combustibility and ASTM E-84/UL 723 for Surface Burning Characteristics.

D. Physical Properties: Plenum insulation shall be single ½" layer with a density of 6 to 8 pounds per cubic foot.

E. Acceptable Manufacturers and Products:
1. 3M Fire Barrier Plenum Wrap 5A+.
2. ETS Schaefer Plenumshield Blanket.
3. Knauf Earthwool 1000° Pipe Insulation with ECOSE Technology.
4. Morgan Advanced Materials – Thermal Ceramics FireMaster PlenumWrap+.
5. Owens Corning Pipe Insulation SSL II with ASJ Max Jacket.
6. Unifrax FyreWrap 0.5 Plenum Insulation.

2.13 FIRESTOPPING

A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:
   1. 3M Corp., Fire Barrier Sealant
   2. Hilti
   3. Owens Corning, Firestopping Insulation.
   4. Pecora, AC-20 FTR
   5. RectorSeal
   6. Specified Technologies Inc.,
   7. United States Gypsum Company SHEETROCK Firecode Compound
   8. Tremco, Tremstop Fyre-Sil.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install leak detection systems, plenum insulation, access doors and sealants in accordance with manufacturer's installation instructions.

3.02 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.04 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Select fastener sizes that will not 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 members.

C. Attach to substrates as required to support applied loads.

3.05 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.06 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
   2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.07 PENETRATIONS:

A. New Construction:
   1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. Construction in Existing Facilities:
   1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches above finished floor level.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section “Basic Piping Materials and Methods”.

3.08 DRIP PANS

A. Provide drip pans in locations indicated on drawings.

B. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.

C. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.

D. Provide drip pan supports every 4’-0”. Provide ¼” galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.

E. Connect ¾” type “L” copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.

F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.

G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.

H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section “Common Work Results for Electrical” Disconnects are specified in Division 26 Section “Enclosed Switches and Circuit Breakers”

I. Coordinate interlock of “Water Present” alarm and “Cable Fault alarm with Building Automation System. Refer to Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system and low voltage power wiring.

3.09 LEAK DETECTION SYSTEM FOR WATER HEATERS

A. Provide leak detection rope all around perimeter of water heater drip pan. Secure rope to pan per manufacturers recommendations.

B. Mount leak detection system controller where indicated on drawings.

C. Interlock control panel with building automation system for alarm signal for “Leak at Water Heaters” and “Cable Fault” alarm. Upon receiving leak alarm signal from control panel, building automation system shall energize motorized ball valve “MBV” to close. Motorized ball valve “MBV” is indicated and specified on the drawings. Refer to Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system and low voltage power wiring.

3.10 ACOUSTICAL PENETRATIONS

A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Domestic Water, Sewer, Drain and Vent Piping
   1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

3.11 PLENUM INSULATION

A. General: Plenum insulation shall be installed as a single layer encapsulation applied directly on the surface of combustible items within fire-rated return air plenums where permitted by the local authority having jurisdiction

B. Overlap: Provide a minimum 1” perimeter and longitudinal overlap at all seams and joints. Seal all cut edges with aluminum foil tape. There shall be no exposed fiber.

C. Secure Attachment: Securely attach insulation using stainless steel tie wire or banding at locations and intervals as recommended by the manufacturer. The entire installation shall comply with the manufacturer’s written installation instructions.

D. Approval: Plenum insulation shall not be installed where not allowed by local authority having jurisdiction. Do not install combustible material within fire-rated return air plenums where the use of plenum insulation is not approved.

END OF SECTION 220500

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SECTION 220515
BASIC PIPING MATERIALS AND METHODS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.02 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.03 SUBMITTALS

A. Refer to Division 1 and Division 22 Section “General Plumbing Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:
   1. Escutcheons
   2. Dielectric Unions
   3. Dielectric Waterway Fittings
   4. Dielectric Flanges and Flange Kits
   5. Mechanical Sleeve Seals
   6. Wall Pipes
   7. Strainers
   8. Flexible Connectors

C. Quality Control Submittals:
   1. Submit welders' certificates specified in Quality Assurance below.

D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.

F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.04 QUALITY ASSURANCE

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.

D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
   1. Pipe Escutcheons:
      a. AWI Manufacturing.
      b. Keeney Manufacturing Company
      c. Wal-Rich Corp.
      d. Jones Stephens Corp.
   2. Dielectric Waterway Fittings:
      a. Precision Plumbing Products, Inc.
   3. Dielectric Unions:
      a. JOMAR International
      b. Smith Cooper International
      c. Watts Regulator Co.
      d. Zurn Industries
   4. Dielectric Flanges and Flange Kits:
      a. Advance Products & Systems
      b. Calpico, Inc.
      c. Pipeline Seal & Insulator, Inc.
      d. Tampa Rubber and Gasket Co., Inc.
      e. Watts Industries Inc.; Water Products Div.
      f. Zurn Industries, Inc.; Wilkins Div.
   5. Strainers – 2” and smaller:
      a. Apollo
      b. Hammond
      c. Milwaukee

d. NIBCO

6. Strainers – 2-1/2" and larger:
   a. Metraflex Co.
   b. Watts Regulator Co.
   c. Zurn Industries, Inc.; Wilkins Div.
7. Mechanical Sleeve Seals:
   a. Advance Products & Systems
   b. Calpico, Inc.
   c. GPT Industries/Link Seal
   d. Metraflex Co.
   e. Proco Products, Inc.
8. Metal Flexible Connectors:
   a. United Flexible, Inc.
   b. Hyspan
   c. Mason Industries, Inc.
   d. Mercer Rubber Co.
   e. Metraflex Co.
   f. Proco Products, Inc.
   g. Resistoflex
   h. Tyler Pipe; Gustin-Bacon Div.
9. Rubber Flexible Connectors:
   a. General Rubber Corp.
   b. Mason Industries, Inc.
   c. Mercer Rubber Co.
   d. Metraflex Co.
   e. Proco Products, Inc.
   f. Uniflex, Inc.
10. Wall Pipes
   a. Josam Mfg. Co.
   b. Smith (Jay R) Mfg. Co.
   c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
   d. Watts Industries, Inc.
   e. Zurn Industries, Inc.; Hydromechanics Div.

2.02 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

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. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.

E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions:
1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.

C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Dielectric Flanges and Flange Kits:
1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.

F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4” and smaller shall be Type 304 stainless steel mesh with 0.062” perforations and screens for 5” and larger shall be Type 304 stainless steel, with 0.125" perforations.
1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure

applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.

2. Solder Ends, 2” and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded Ends, 2” and Smaller: Cast bronze body, screwed screen retainer with centered blowdown fitted with pipe plug.
4. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
5. Threaded Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug..
6. Flanged Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug .Sleeves:
    a. Sleeve: Refer to Division 22 Section “Common Work Results for Plumbing” for sleeve materials.

G. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

H. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.
1. Stainless-Steel-Hose, Flexible Connectors: For 2” and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
2. Bronze Hose, Flexible Connectors: For 2” and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2” and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

2.05 WALL PIPES

A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.06 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2” wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s installation instructions.

3.02 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.03 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

I. Verify final equipment locations for roughing in.

3.04 PIPING PROTECTION

A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.05 PENETRATIONS

A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.

B. Provide escutcheons for exposed pipe penetrations of interior floors, walls, ceilings and under cabinets and millwork. Use deep pattern escutcheons where required.

C. Above Grade Concrete or Masonry Penetrations
   1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
      a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
      b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
      c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
         1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
         2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
      d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
   2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1” annular clear space between inside of sleeve and outside of insulation.
   3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½” of sealant.

D. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
   1. Use type and number of sealing elements recommended by manufacturer 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.
   2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.

E. Elevated Floor Penetrations of Waterproof Membrane:
   1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1” above finish floor. Size wall pipe for minimum ½” annular space between pipe and wall pipe.
   2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1” annular clear space between inside of sleeve and outside of insulation.
   3. Pack with mineral wool and seal both ends with minimum of ½” of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

F. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.

G. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.

H. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

I. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Cover exterior sealant with grout, minimum ½" thick and paint grout to match exterior color, with color selection by the architect. Refer to Division 07 Section "Joint Sealants" for materials and installation..
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

J. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.

K. Acoustical Barrier Penetrations: Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. The internal diameter of the sleeve shall be a minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
1. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.06 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install components with pressure rating equal to or greater than system operating pressure.

D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.

E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.

F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2” and larger.

G. Install dielectric unions for piping 2” and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.

H. Install dielectric flanges for piping 2-1/2” and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.

I. Install dielectric unions for piping 2” and smaller to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

J. Install dielectric flanges for piping 2-1/2” and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

K. Install dielectric waterway fittings for piping 2” and smaller for copper or brass pipe connections to carbon steel equipment connections.

L. Install dielectric flanges for piping 2-1/2” and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.

M. Dielectric Flange Installation:
   1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
   2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
   3. Provide full face gasket with pressure rating equal to system served.
   4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.07 JOINTS

A. Steel Pipe Joints:
   1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
   2. Pipe Larger Than 2":
      a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
      b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
      c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:
   1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
   2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

C. Joints for other piping materials are specified within the respective piping system Sections.

3.08 FLEXIBLE CONNECTORS

A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.
   1. Install stainless steel connectors for domestic water copper equipment connections 2” and smaller.
   2. Install bronze connectors for non-domestic water copper equipment connections 2” and smaller.
   3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2” and larger.

B. Install connectors according to manufacturer’s recommendations.

3.09 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION 220515

PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM

Project Name:
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks

_____
_____
_____
Contractor Supervisor's signature: _____

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SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of meters and gauges:
   1. Temperature gauges and fittings.
   2. Pressure gauges and fittings.

1.02 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
   1. Product data for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
   2. Product certificates signed by manufacturers of meters and gauges certifying accuracy under specified operating conditions and products' compliance with specified requirements.
   3. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Glass Tube Industrial Thermometers:
      a. H. O. Trerice Co.
      b. Marshalltown Instruments, Inc.
      c. Miljoco Corporation
      d. Weiss Instruments, Inc.
      e. Weksler Instruments Corp.
      f. Winters Instruments
   2. Bimetal Dial Thermometers:
      a. Ashcroft Dresser Industries Instrument Div.
      b. Ernst Gage Co.
      c. H. O. Trerice Co.
      d. Marshalltown Instruments, Inc.
      e. Miljoco Corporation
      f. Tel-Tru Manufacturing Co., Inc.

g. Weiss Instruments, Inc.
h. Weksler Instruments Corp.
i. Winters Instruments

3. Insertion Dial Thermometers:
   a. Ashcroft Dresser Industries Instrument Div.
   b. H. O. Trerice Co.
   c. Miljoco Corporation
   d. Tel-Tru Manufacturing Co., Inc.
   e. Weiss Instruments, Inc.
   f. Weksler Instruments Corp.
   g. Winters Instruments
4. Direct-Mount Filled-System Dial Thermometers:
   a. Ashcroft Dresser Industries Instrument Div.
   b. H. O. Trerice Co.
   c. KOBOLD Instruments, Inc.
   d. Marsh Instrument Co., Unit of General Signal.
   e. Miljoco Corporation
   f. Weiss Instruments, Inc.
   g. Weksler Instruments Corp.
   h. Winters Instruments
5. Remote-Reading Filled-System Dial Thermometers:
   a. Ametek, U.S. Gauge Div.
   b. Ashcroft Dresser Industries Instrument Div.
   c. H. O. Trerice Co.
   d. Marsh Instrument Co., Unit of General Signal.
   e. Miljoco Corporation
   f. Tel-Tru Manufacturing Co., Inc.
   g. Weiss Instruments, Inc.
   h. Weksler Instruments Corp.
   i. Winters Instruments
6. Thermometer Wells: Same as for thermometers.
7. Pressure Gauges:
   a. Ametek, U.S. Gauge Div.
   b. Ashcroft Dresser Industries Instrument Div.
   c. Ernst Gage Co.
   d. H. O. Trerice Co.
   e. Marsh Instrument Co., Unit of General Signal.
   f. Marshalltown Instruments, Inc.
   g. Miljoco Corporation
   h. Weiss Instruments, Inc.
   i. Weksler Instruments Corp.
   j. WIKA Instruments Corp.
   k. Winters Instruments
8. Pressure Gauge Accessories: Same manufacturers as for pressure gauges.

2.02 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:
   1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).
   2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).

2.03 GLASS TUBE INDUSTRIAL THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Non-red color reading, non-toxic organic spirit-filled glass tube, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.04 BIMETAL DIAL THERMOMETERS

A. Type: Direct mounted, bimetal, universal angle.

B. Case: Stainless steel, glass lens, 5-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Element: Bimetal coil.

E. Scale: Satin faced, nonreflective aluminum, permanently etched marking.

F. Stem: Stainless steel for separable socket, length to suit installation.

2.05 DIAL-TYPE INSERTION THERMOMETERS

A. Type: Bimetal, stainless steel case and stem, 1-inch-diameter dial, dust- and leakproof, 1/8-inch-diameter tapered-end stem with nominal length of 5 inches.

2.06 DIRECT-MOUNT FILLED-SYSTEM DIAL THERMOMETERS

A. Type: Vapor actuated, universal angle.

B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube.

E. Movement: Brass, precision geared.

F. Scale: Progressive, satin faced, nonreflective aluminum, permanently etched markings.

G. Stem: Copper-plated steel, aluminum, or brass, for separable socket, length to suit installation.

2.07 REMOTE-READING FILLED-SYSTEM DIAL THERMOMETERS

A. Type: Vapor actuated.

B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.

C. Movement: Brass, precision geared.

D. Scale: Progressive, satin faced, nonreflective aluminum, permanently etched markings.

E. Tubing: Bronze double-braided armor over copper capillary, length to suit installation.

F. Bulb: Copper with separable socket for liquids, averaging element for air.

2.08 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.09 PRESSURE GAUGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.

B. Case: Cast aluminum or stainless steel case, glass lens, 4-1/2-inches diameter.

C. Connector: Brass, 1/4-inch NPS.

D. Scale: White coated aluminum, with permanently etched markings.

E. Accuracy: Plus or minus 1 percent of range span.

F. Range: Conform to the following:
   1. Vacuum: 30 inches Hg to 15 psi.
   2. All fluids: 2 times operating pressure.

G. Liquid-Filled: Provide liquid filled gauges where specified in Part 3 of this section.

2.10 PRESSURE GAUGE ACCESSORIES

A. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

PART 3 EXECUTION

3.01 THERMOMETERS INSTALLATION

A. Install in the following locations and elsewhere as indicated:
   1. At outlet of each domestic water heater.

B. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.02 INSTALLATION OF PRESSURE GAUGES

A. Install in the following locations, and elsewhere as indicated:
   1. Provide liquid-filled gauge at suction and discharge of each pump.
   2. At discharge of each pressure-reducing valve.
   3. At building water service entrance.

B. Pressure Gauge Needle Valves: Install in piping tee with snubber.

END OF SECTION 220519

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SECTION 220523
GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes general duty valves common to most plumbing water distribution piping systems.
   1. Special purpose valves are specified in individual piping system specifications.

B. Contractors Option:
   1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined plumbing piping systems to connect plumbing piping where used shall be provided in compliance with specification Section 221111 “Mechanically Joined Plumbing Piping Systems”.

1.02 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

B. CWP: Cold working pressure.

C. EPDM: Ethylene propylene diene monomer copolymer rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluorethylene

G. RS: Rising stem.

H. TFE: Tetrafluoroethylene

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
   1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.

B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
   1. MSS SP 67 “Butterfly Valves”
   2. MSS SP 70 “Gray Iron Gate Valves, Flanged and Threaded Ends”
   3. MSS SP 71 “Gray Iron Swing Check Valves, Flanged and Threaded Ends”
   4. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
   5. MSS SP 80 “Bronze Gate, Globe, Angle and Check Valves”
   6. MSS SP 85 “Gray Iron Globe and Angle Valves, Flanged and Threaded Ends”
   7. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”
   8. MSS SP 125 “Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided”
   9. MSS SP 139 “Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications”

D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.02 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.
   1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:
   1. Handwheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6-inch and smaller.

3. Chain-wheel operators, for valves 2-1/2-inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
4. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. End Connections: As indicated in the valve specifications.
1. Threads: Comply with ANSI B1.20.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
3. Solder-Joint: Comply with ANSI B16.18.
   a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.03 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body, solid wedge and bonnet of ASTM B 584 lead free cast bronze; brass packing gland and stem of ASTM B283 naval brass; with solder ends, non-asbestos composition packing, and malleable iron handwheel.

B. Gate Valves, 2-1/2-Inch and Larger: Meeting MSS SP-70 and lead free with FDA epoxy coating; Class 125, 200-psi CWP, iron body, lead free bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with lead free brass stem, with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly.

2.04 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, regular port, blowout-proof stem and chrome-plated lead free brass ball, with replaceable TFE seats and seals, solder ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200 CWP, lead free with FDA epoxy coating, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, FDA epoxy coating, PTFE gasket, stem seal and seat.

2.05 GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP; body, disc and screwed bonnet of ASTM B 584 lead free cast bronze; brass replaceable composition disc and stem of ASTM B 283 alloy C46400 naval brass, brass packing gland, with solder ends, non-asbestos composition packing, and malleable iron handwheel.

B. Globe Valves, 2-1/2-Inch and Larger: Meeting MSS SP-85; Class 125, 200-psi CWP; iron body and bolted bonnet conforming to ASTM A 126, Class B; with FDA epoxy coating, outside screw

and yoke, lead free bronze mounted, lead free bronze shaft, flanged ends, and non-asbestos composition packing, and two-piece backing gland assembly.

2.06 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2-Inch and Larger: Meeting MSS SP-67 and lead free; 200-psi CWP; lug-type body constructed of ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze or CF8M (316) stainless steel disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks for sizes 2-1/2 through 6 inches and gear operators with position indicator for sizes 8 inch and larger. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required.

2.07 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.

B. Swing Check Valves, 2-1/2-Inch and Larger: Meeting MSS SP-71 and lead free; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with FDA epoxy coating, horizontal swing, lead free bronze disc with lead free bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

C. Wafer Check Valves: Meeting MSS SP 125, Class 125, 200-psi CWP, lead free cast-iron body, with FDA epoxy coating, replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

D. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 EXECUTION

3.01 INSTALLATIONS

A. Install valves in accordance with manufacturer’s installation instructions.

B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:

H. Swing Check Valves: Horizontal position with hinge pin level.

I. Wafer Check Valves: Horizontal or vertical position, between flanges.

J. Lift Check Valve: With stem upright and plumb.

3.02 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
2. Copper Tube Sizes 2-1/2 Inch and Larger: Flange ends.

3.03 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Domestic Hot and Cold Water Service

VALVE TYPE	2" AND SMALLER	2-1/2" AND LARGER
Ball	150	200
Butterfly	N/A	200
Gate	125	125
Globe	125	125
Check	125	125

3.04 VALVE SCHEDULE

A. Gate Valves - 2 inch and smaller:

MANUFACTURER	SOLDER NRS
Apollo	102S-LF
Hammond	UP-668
Milwaukee	UP668
NIBCO	S-113-LF

B. Gate Valves - 2-1/2 inch and larger – Class 125:

MANUFACTURER	OS&Y RS	NRS
Apollo	611F-LFA	610F-LFA

C. Ball Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS

Apollo	70LF-200
Hammond	UP8511
Milwaukee	UPBA-150
NIBCO	N/A

D. Ball Valves (full port) – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo	77CLF-200	77CLF-100
Hammond	UP8311A	UP8301A
Milwaukee	UPBA-450	UPBA-400
NIBCO	S-585-80-LF	T-585-80-LF

E. Ball Valves (full port – SS Ball) – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo	77CLF-240	77CLF-140
JOMAR	S200CSSG	T200CSSG
Hammond	UP8313A	UP8303A
Milwaukee	UPBA-450S	UPBA-400S
NIBCO	S-585-66-LF	T-585-66-LF

F. Iron Body Ball Valves (full port) – 2-1/2” and larger:

MANUFACTURER	FLANGED ENDS
Apollo	6PLF
Watts	G4000-FDA

G. Globe Valves - 2-1/2 inch and larger – Class 125:

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Apollo	711F-LFA	N/A

H. Globe Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS
Apollo	120S-LF
Hammond	UP-418
Milwaukee	UP1502
NIBCO	S113

I. Butterfly Valves (aluminum-bronze disc) - 2-1/2 inch and larger:

MANUFACTURER	LEVER	GEAR
Apollo	LD141 xx BE1*	LD141 xx BE2*
Hammond	6411-01	6411-03
Milwaukee	ML233E	ML333E
NIBCO	LD-2000-3	LD-2000-5
Watts	XXBF-03-121-15	XBF-03-121-1G

* xx = Valve Size

J. Butterfly Valves (stainless steel disc) - 2-1/2 inch and larger:

MANUFACTURER	LEVER	GEAR
Apollo	LD141 xx SE11*	LD141 xx SE12*
Hammond	6421-01	6421-03
Keystone	222	222
Milwaukee	ML234E	ML334E
NIBCO	LD-2022-3	LD-2022-5
Watts	XXBF-03-131-15	XXBF-03-131-1G

* xx = Valve Size

K. Swing Check Valves – 2 inch and smaller – Class 125:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

L. Swing Check Valves - 2-1/2 inch and larger – Class 125:

MANUFACTURER	Flanged Ends
Apollo	910F-LFA

M. Wafer Check Valves – Class 125:

MANUFACTURER	MODEL
Apollo	910WB-LF

N. Lift Check Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

3.05 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:
   1. Gate Valves, 2” and smaller: Class 125, with cast bronze body.
   2. Gate Valves, 2-1/2”: Class 125 with cast-iron body.
   3. Ball Valves, 2” and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.
   4. Ball Valves, 2-1/2” and larger: 200-psi CWP cast iron body.
   5. Globe Valves, 2” and smaller: Class 125, with cast bronze body and bronze or teflon disc.
   6. Globe Valves, 2-1/2” and larger: Class 125, with cast iron body and bronze or teflon disc.
   7. Butterfly Valves, 2-1/2” and larger 200-psi working pressure with cast or ductile iron body
   8. Swing Check, 2” and smaller: Class 125, cast bronze with rubber seat.
   9. Check Valves, 2-1/2” and larger: Class 125, swing or wafer type as indicated.

3.06 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.07 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION 220523

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Support and attachment components.

B. Horizontal-piping hangers and supports.

C. Shields

D. Vertical piping clamps

E. Pipe alignment guides.

F. Pipe anchors.

G. Pre-engineered roof supports

H. Anchors and fasteners.

I. Miscellaneous materials.

J. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
   2. Division 22 “Water Distribution Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
   3. Division 22 “Sanitary Drainage & Vent Piping and Specialties”, for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
   4. Division 22 “Storm Drainage & Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.03 SUBMITTALS

A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.

B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.

C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."

E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
   1. Application of protective inserts, and shields at pipe hangers for each type of insulation and hanger.

F. Installer's Qualifications: Include evidence of compliance with specified requirements.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Deferred Submittals: Submit signed and sealed drawings that indicate the design and installation requirements of pre-engineered roof supports can withstand the design criteria listed in this specification. Include installation requirements for anchoring to the roof structure. The Engineer is not responsible and will not provide the seal and signature. Deliver submittal to the local AHJ for approval prior to installation of the contractor provided, pre-engineered roof supports.

1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Field-Welding:
   1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
   2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."

D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Deferred Submittals: Signed and sealed by a professional engineer or National Institute for Certification in Engineering Technologies (NICET) stamp and signature. The professional engineer shall be licensed in the same state in which the project is located.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.06 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

PART 2 PRODUCTS AND MATERIALS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Edit material below based upon indoor dry, indoor wet, outdoor or Natatoriums
7. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
   a. Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
   b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
   c. Natatorium or other treated pool environments: Type 316 stainless steel.
   d. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.

e. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
f. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
g. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
a. Cooper B-Line.
b. Ferguson Enterprises/FNW.
c. PHD Manufacturing.
d. Thomas & Betts Corporation.
e. Unistrut, a brand of Atkore International Inc.
f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-69, Type 59, MSS SP-89, and . Welds shall comply with AWS D1.1.
4. Channel Material:
a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
d. Natatorium or other treated pool environments: Type 316 stainless steel.
e. All nuts, brackets, and clamps shall have the same finish as the channel.
5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

C. Hanger Rods:
1. Material:
a. Indoor Dry Locations: Zinc-plated steel.
b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
c. Natatorium or other treated pool environments: Type 316 stainless steel.
2. Threaded both ends or continuously threaded.
3. Minimum Size: Reference piping specification sections for rod thicknesses.
4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12”. Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.
5. HORIZONTAL PIPING HANGERS AND SUPPORTS

D. MANUFACTURERS
1. Anvil International
2. ASC Engineered Solutions.
3. Cooper B-Line, Inc.
4. Elite Components
5. ERICO/Michigan Hanger Co./Caddy

6. Ferguson/FNW.
7. Halfen-DEHA.
8. Hilti.
9. National Pipe Hanger Corporation.
10. PHD Manufacturing.
11. Power-Strut.
12. Unistrut.

E. Single Hangers:
1. Split Ring: Carbon steel, adjustable swivel, split ring type.
2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
3. Clevis Hanger: Carbon steel, adjustable, clevis type.
4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

F. Trapeze and Strut-mounted Supports:
1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.

G. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
   a. ASC Engineered Solutions.
   b. Holdrite.
   c. Klo-Shure.
2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.

H. Spring Hangers:
1. Reference Section “Vibration Isolation for Plumbing Piping and Equipment” for spring isolation hangers.

I. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.

J. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

K. Pre-Insulated Supports:
1. Manufacturers:
   a. Aeroflex USA, Inc.
   b. ASC Engineered Solutions

c. Armacell.
d. Buckaroos, Inc.
e. Cooper B-Line, Inc.
f. Pipe Shields, Inc.

2. General Construction and Requirements:
   a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
   b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
   c. Waterproof calcium silicate insulation shall conform to ASTM C795.
   d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
   e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.02 SHIELDS

A. Insulation Protection Shield:
1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension.
2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.
4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft) 5	6	7	8	9	10
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

B. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

C. Plastic Shields:
1. Manufacturers:
   a. Armacell.
   b. Eaton.

c. Hydra-Zorb.
d. PHD Manufacturing.
e. Zsi Foster.

2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.03 VERTICAL-PIPING SUPPORTS

A. Manufacturers:
1. ASC Engineered Solutions.
2. Cooper B-Line, Inc.
3. Halfen-DEHA.
4. Hilti.
5. ERICO/Michigan Hanger Co.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing.
8. Power-Strut.
9. Unistrut.

B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.

C. Riser Clamps with pre-manufactured polymer insert:
1. Manufacturers:
a. Hydra-Zorb; Titan Riser Clamp.
b. National Pipe Hanger.
c. Pipe Hangers, Inc.

D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.04 PIPE ALIGNMENT GUIDES

A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.
1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches and Larger: Roller type.
3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

2.05 PIPE ANCHORS

A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.

B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

2.06 PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Manufacturers:
1. Airtec.
2. ASC Engineered Solutions.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy.
6. Ferguson/FNW.
7. Miro.
8. PHP Systems/Design.
9. PHD Manufacturing.
10. Roof Top Blox.
11. Unistrut, a brand of Atkore International Inc.
12. Zsi Foster.

B. General: Pre-engineered devices with embedded pipe support fixtures as specified.

C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
1. Up to 12 inch strut length support: 18 inch x 18 inch.
2. Up to 16 inch strut length support: 24 inch x 18 inch.
3. Up to 24 inch strut length support: 30 inch x 18 inch.
4. Thickness: Minimum 3/16 inch thick.

D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
2. Width: Nominal 4 inches.

E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.07 ANCHORS AND FASTENERS

A. Manufacturers:
1. Hilti, Inc.
2. Illinois Tool Works, Inc.
3. Phillips.
4. Powers Fasteners, Inc.
5. Rawl.
6. Simpson Strong-Tie Company Inc.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   1. Concrete: Use preset concrete inserts or expansion anchors.
   2. Solid or Grout-Filled Masonry: Use expansion anchors.
   3. Hollow Masonry: Use toggle bolts.
   4. Hollow Stud Walls: Use toggle bolts.
   5. Steel: Use beam clamps.
   6. Sheet Metal: Use sheet metal screws.
   7. Wood: Use wood screws.
   8. Plastic and lead anchors are not permitted.
   9. Hammer-driven anchors and fasteners are permitted only as follows:
      a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
      b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.

C. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   1. Comply with MFMA-4.
   2. Channel Material: Use galvanized steel.
   3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
   4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rode dimensions.
   5. Manufacturers:
      a. Same as manufacturer of metal channel (strut) framing system.
      b. DeWalt “Bang-It” concrete inserts.

D. Post-Installed Concrete and Masonry Expansion Anchors:
   1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
   2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.

E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

F. Vibration Isolation Anchors: Reference Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment” for vibration isolation anchors.

2.08 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Malleable Iron: ASTM A47

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 ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION, GENERAL

A. Install hangers and supports in accordance with manufacturer's installation instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.

B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

C. Space attachments within maximum piping span length specified in Division 22 piping sections.

D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

E. Install hangers, supports, clamps and attachments to support piping properly from building structure.

F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

G. Hanger and clamps sizing:
   1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
   2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.

3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.

H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.
1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
   a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
   b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".

I. Install building attachments within concrete or to structural steel.
1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

K. Install appropriate types of hangers and supports to allow controlled 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. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

N. Insulated Piping: Comply with the following installation requirements.
1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
   a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.
2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.
   a. Exception for horizontal cold–piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with

length specified for pipe size and insulation thickness to prevent puncture or other damage.

3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".

P. Vertical Piping Risers:
1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.

Q. Wire Rope Hanging Systems:
1. Install in accordance with manufacturer's instructions.
2. Supported load shall not exceed manufacturer's recommended load rating.
3. Applications for Pipe Supports:
   a. 3 inch and smaller.
   b. Wire rope hanging system is not allowed for steam or steam condensate piping.
4. Do not support pipe by wrapping the rope around the pipe.
5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in Division 22 piping sections.
6. Install cast-in-place concrete inserts in elevated concrete slabs.
7. Install bream clamps for attachment to structural beams as required.

R. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.

S. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.04 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise. Install pipe insulation at guide to not interfere with movement of pipe within the guide.

B. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.

C. Anchor to building substrate.

3.05 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Spacing: 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.

3.06 INSTALLATION OF PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Install pre-engineered roof pipe supports to rest on the roofing membrane without attachment to the roof structure or penetration through the roofing assembly.

B. Install pre-engineered roof pipe supports anchored to the roof structure.
   1. Install supports to meet the specified design criteria.
      a. Building Design Risk Category: II.
      b. EQUIPMENT SUPPORTS

C. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

D. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.

E. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

F. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
   1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

J. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

K. Grouting: Place grout under supports for piping and equipment.

3.07 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.08 FIELD QUALITY CONTROL

A. Examine support and attachment components for damage and defects.

B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section “Painting.”
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

F. Correct deficiencies and replace damaged or defective support and attachment components.

3.09 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:

C. Single Hangers:
   1. All pipe sizes 1-1/2 inch and less:
      a. Band hanger.
      b. Swivel split ring.
      c. Clevis hanger.
   2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
   3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
   4. All drainage pipe sizes: Clevis hanger.

D. Trapezes and Strut-mounted Supports:
   1. All pipe sizes less than 6 inches: Two-piece clamp.
   2. Pipe sizes 6 inches and greater: Roll support.

E. Wall Supports:
   1. Pipe sizes 3 inches and less:
      a. Two-hole strap mounted to wall.
      b. Welded steel bracket with reinforced angle or strut.
   2. Pipe sizes 4 inches and greater:
      a. U-bolt
      b. Welded steel bracket with reinforced angle or strut.

F. Floor Supports:
   1. Pipe sizes 4 inches and less: Pipe saddle.
   2. Pipe sizes 6 inches and greater: Roll support.

END OF SECTION 220529

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SECTION 220548
SEISMIC CONTROLS FOR PLUMBING SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 20 Section “Seismic Controls for MEP/F/T Systems” for general requirement and related documents that apply to this section.

1.03 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUMMARY

A. Seismic bracing, restraints, and controls for all plumbing systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEP/F/T Systems”.

1.05 SUBMITTALS

A. Provide submittals as required by Division 20 Section “Seismic Controls for MEPFTR Systems” for all plumbing systems specified herein.

PART 2 PRODUCTS AND MATERIALS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION 220548

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SECTION 220550
VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. It is the intent of this specification to provide vibration isolation supports for Plumbing equipment as scheduled at the end of this Section.

B. This work shall include all materials and labor required for the installation of the vibration isolation devices.

C. Vibration isolators shall be selected by the weight distribution to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule included at the end of this Section.

D. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.

E. All vibration isolation devices shall be treated for corrosion resistance using galvanization for exterior applications and painting for interior applications.

F. Related Sections:
1. Division 22 Section “Common Work Results for Plumbing” for materials and methods for concrete equipment pads.
2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for flexible connectors.
3. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hangers and supports.
4. Division 22 Section “Domestic Booster Pumps,” for materials and methods for domestic booster pumps.

1.02 WORK INCLUDED

A. Provide complete vibration isolation systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:
1. Foundations, vibration isolation, and supports for rigidly supported equipment.
2. Vibration Isolation

1.03 CONTRACTOR'S RESPONSIBILITY

A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically

mentioned herein or in the Contract Documents, shall be provided by the Contractor without claim for additional payment.

B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly to the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.04 MANUFACTURER'S RESPONSIBILITIES

A. Manufacturer of vibration isolation equipment shall have the following responsibilities:
1. Determine vibration isolation for all equipment and systems in accordance with the local governing code.
2. Provide piping and equipment isolation systems as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

1.05 SUBMITTALS

A. Submittal data shall show type, size, and deflection of each isolator proposed. Include clearly outlined procedures for installing and adjusting the isolators.

B. Submit a vibration isolation system schedule indicating the following:
1. Manufacturer, type, model number, size
2. Height when uncompressed and static deflection of each isolation element
3. Spring constant of each isolation element
4. Estimated imposed load on each isolation element
5. Spring o.d., free operating, and solid heights
6. Design of supplementary bases.
7. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing.
8. Piping isolators shown and identified on piping layout drawings.
9. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of his equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by

this trade which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, etc.

1.06 QUALITY ASSURANCE

A. It is the objective of this Specification to provide for the control of vibration due to the operation of machinery or equipment, and/or due to interconnected piping or conduit.

B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. All vibration isolation equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:
1. Amber Booth.
2. Kinetics Noise Control.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Mounting and Controls.

2.02 GENERAL

A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

2.03 VIBRATION ISOLATORS

A. GENERAL
1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The isolator schedule shall take precedence.
2. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
3. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, the amount of deflection can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
4. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
5. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10%.
6. All neoprene mountings shall have a Shore hardness of 30 to 60 ±5, or as specified herein, after minimum aging of 20 days or corresponding over-aging.
7. Housed or caged spring isolators are not acceptable.

8. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

B. ISOLATOR TYPE WP
1. Type WP (Waffle Pads) shall be 5/16 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type WP: Mason Industries Type W or as approved.)

C. ISOLATOR TYPE MWP
1. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 inch thick ribbed or waffle neoprene pads sandwiching a 16 gauge stainless steel shim plate. The pad shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type MWP: Mason Industries Type WSW or as approved.)

D. ISOLATOR TYPE DDNM
1. Type DDNM (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
3. (Type DDNM: Mason Industries Type ND or as approved.)

E. ISOLATOR TYPE DDNH
1. Type DDNH (Double Deflection Neoprene Hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.

2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches.
3. (Type DDNH: Mason Industries Type HD or as approved.)

F. ISOLATOR TYPE SPNM
1. Type SPNM (Spring and Neoprene Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
2. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 inch, and the minimum static deflection for equipment mounted above grade level shall be 2 inches.
3. Two Type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
5. (Type SPNM: Mason Industries Type SLFH or as approved.)

G. ISOLATOR TYPE SPNH
1. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches.
3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
4. (Type SPNH: Mason Industries Type 30N or as approved.)

H. BASE TYPE CIB
1. Inertia base Type CIB (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured.
2. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
3. When the concrete base is "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.

4. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
5. (Base Type CIB: Mason Industries Type KSL or as approved).

I. NEOPRENE MOUNTING SLEEVES
1. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

J. PIPE FLEXIBLE CONNECTORS
1. Refer to Section “Basic Piping Materials and Methods” for requirements for flexible pipe connectors.

PART 3 EXECUTION

3.01 GENERAL

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.

B. All floor-mounted equipment shall be erected on concrete equipment pads over the complete floor area of the equipment, unless otherwise specified herein. Refer to Section “Basic Piping Materials and Methods” for concrete equipment pad requirements. These pads shall be integrally keyed to structural slab. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted on concrete equipment pads unless otherwise specified herein.

C. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

D. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 1/4" maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.

E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete equipment pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short- circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

F. Piping or plumbing equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

H. All plumbing equipment not specifically identified in this specification that contains rotating or vibrating elements, and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM neoprene isolators as appropriate.

I. All wiring connections to plumbing equipment on isolators shall be made with a minimum 18 inch long flexible conduit in a “U” shaped loop.

J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.

K. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

M. Refer to Vibration Isolation Schedule at the end of this Section.

3.02 DOMESTIC BOOSTER PUMPS

A. Packaged domestic booster pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

B. Packaged domestic booster pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to a spring supported concrete inertia base and be provided with vibration isolators as scheduled in the table at the end of this section. Provide concrete inertia base with thickness as scheduled in the table at the end of this section and provide with a 2" minimum operating clearance between the base and equipment pads.

3.03 SUPPORT OF PIPING

A. The following water and condensate piping shall be resiliently supported:
   1. Piping within 50 feet of connected rotating equipment.
   2. Piping installed below or adjacent to noise sensitive areas.

B. Pipes connected to equipment installed on spring vibration isolators shall be suspended or supported by Type SPNM or Type SPNH isolators. Provide vibration isolation anchors and guides as specified elsewhere in this section. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.

C. Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.

D. Where a pipe run connects multiple items of equipment in the mechanical room the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

E. Resilient diagonal mountings or other approved devices shall be provided as required to limit piping motion due to equipment startup or shut down, to a maximum of 1/8".

F. Water piping hanger rod isolators shall contain a steel spring in series with a 1/4" acoustical neoprene pad within a steel box retainer. The hanger rod isolator assembly shall be rigidly supported from the spring sub-assembly and shall not contact the steel box retainer. Clearances in the isolator design shall be capable of accepting a 15 degree misalignment in any direction from the vertical.

G. The steel spring element of the assembly shall be designed to have a minimum surge frequency of 340 HZ and a minimum deflection of 3/4".

H. Hanger rod isolators for steam and condensate piping including steam pressure reducing valve stations shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".

I. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08" and shall be resiliently supported from the building structure with mountings as described above. Supported piping from the supplementary steel shall be rigidly suspended or supported.

J. Pre-compressed type hanger rod isolators shall be provided for all water piping greater than 12" diameter and all supplementary steel supports. The pre-compression shall be factory set at 75% of rated deflection.

K. Where isolated water piping 8" and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of the beam. For piping 6" and smaller, beam clamps may be used in lieu of welding subject to approval of beam clamp selection.

L. [Except as noted elsewhere in this section, all 2-inch and smaller domestic water piping that is installed outside equipment rooms shall be isolated from the structure with sponge neoprene, felt or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.]

3.04 PIPING ANCHORS, GUIDES AND SUPPORTS

A. General: Pipe riser guides, anchors and supports including piping anchors in mechanical equipment rooms or occupied spaces shall be isolated from the building structure such that there shall be no direct metal to metal contact of the piping with the building structure.

B. Piping Anchors and Guides
   1. The all directional pipe anchor isolation mountings shall consist of a telescoping arrangement of two sizes of steel tubing separated by a minimum of 1/2" thick heavy duty neoprene and canvas duct isolation pad. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. The allowable load on the isolation material shall not exceed 500 psi.
   2. Steel guides shall be welded to the pipe at a maximum spacing of 90°. The outside diameter of the opposing guide bars shall be smaller than the inside diameter of the pipe riser clamp in accordance with standard field construction practice. Each end of the pipe guide shall

be rigidly attached to an all directional pipe anchor isolation mounting which in turn, shall be rigidly fastened to the steel framing within the shaft.

3. Low temperature piping guides shall be constructed with a 360 degree 10 gauge metal sleeve around the piping. The thermal insulation requirements for the piping shall be provided between the piping and the sleeve. Heavy duty neoprene and canvas duct isolation pad of thickness equal to thermal insulation requirements shall space the metal sleeve away from the piping with urethane or other suitable thermal insulation provided in the voids between the pipe-sleeve and isolation pan material. The metal sleeve outside diameter shall be smaller than the pipe riser clamp inside diameter in accordance with standard field construction practice. The pipe riser clamp shall be rigidly attached to the steel framing within the shaft.

C. Piping Supports:

1. Piping supports within shafts shall be provided with suitable bearing plates and two layers 1/4" thick ribbed or waffled neoprene pad loaded for 50 psi maximum. The isolation pads shall be separated with 1/4" steel plate. The isolation pads shall be Type WP or approved equal.
2. Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy duty neoprene and canvas duct isolation pad separated by 1/4" thick steel plate. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with resilient sleeves and washers. All pipe support resilient materials shall be HL Mason Industries, Inc., or as approved.

3.05 FLEXIBLE PIPING CONNECTORS

A. Flexible piping connectors shall be installed to connect piping diameter 2” or greater to reciprocating or rotating equipment.

3.06 PIPE RISER SUPPORTS

A. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.

B. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators and central anchors designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.

3.07 WIRING

A. All wiring connections to plumbing equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 18 inch long flexible conduit in a “U” shaped loop. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.08 FIELD QUALITY

A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

3.09 ADJUSTMENT AND TESTING

A. Site Access: During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and his representatives.

B. Contractor’s Vibration Isolation Report: The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Architect which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

C. Consultant’s Inspection: Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by the vibration isolation report.

3.10 GUARANTEE

A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

3.11 SCHEDULE OF VIBRATION ISOLATORS

Equipment	Base Type	Isolator Type	Static Deflection
Base-mounted pumps (less than 50 HP) (Slab-On-Grade)	Equipment Pad		
Base-mounted pumps (50 HP or greater) (Slab-On-Grade)	Inertia Base CIB	SPNM	0.75”
Base-mounted pumps (3 hp or greater) (Suspended Slab)	Inertia Base CIB	SPNM	2”
Base-mounted pumps (less than 3 hp) (Suspended Slab)	Equipment Pad	DDNM	.4”

In-Line Pumps ½ HP & Larger		SPNH	1.75”
Domestic Booster Pumps (Slab on Grade)	Equipment Pad	MWP	0.25
Domestic Booster Pumps (Suspended Slab)	Inertia Base CIB	SPNM	2”
Piping		Isolation as per specification.	

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SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.

B. Types of identification devices specified in this Section include the following:
1. Painted Identification Materials
2. Plastic Pipe Markers
3. Plastic Tape
4. Underground-Type Plastic Line Marker
5. Valve Tags
6. Valve Schedule Frames
7. Engraved Plastic-Laminate Signs
8. Plastic Equipment Markers
9. Plasticized Tags

1.02 CODES AND STANDARDS:

A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section “General Plumbing Requirements.”

1.04 SPARE PARTS

A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
1. Advanced Graphic Engraving, LLC.
2. Brady Co.
3. Brimar Industries, Inc.
4. Craftmark.
5. Kolbi Pipe Marker Co.
6. Seton

2.02 PLUMBING IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.03 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1-1/4" high letters for ductwork and 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Stencil paint shall be exterior type, oil based, alkyd enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Identification paint shall be oil based, alkyd enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.04 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid Snap-On, color-coded pipe markers, complying with ANSI A13.1

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Adhesive lap joint in pipe marker overlap.
   3. Laminated or bonded application of pipe marker to pipe (or insulation).
   4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
   1. Laminated or bonded application of pipe marker to pipe (or insulation).
   2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
   3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

G. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.

H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

2.05 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.06 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
   1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.07 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
   1. Provide 1-1/2" diameter tags, except as otherwise indicated.
   2. Fill tag engraving with black enamel.

B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
   1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.

C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
   1. Provide 1-1/8" sq. white tags with black lettering.

D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.08 CEILING TACKS

A. Description: Steel with 3/4” diameter color coded head.

B. Color:
   1. Comply with ANSI A13.1, except where another color selection is indicated.

2.09 ACCESS PANEL MARKERS

A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.10 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.11 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for plumbing fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.12 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
   1. Green: Cooling equipment and components.
   2. Yellow: Heating equipment and components.
   3. Yellow/Green: Combination cooling and heating equipment and components.
   4. Brown: Energy reclamation equipment and components.
   5. Blue: Equipment and components that do not meet any of the above criteria.
   6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
   1. Name and plan number.
   2. Equipment service.
   3. Design capacity.
   4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.13 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.14 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
   1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification

after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Application: Provide piping system identification for the following systems:
   1. Domestic cold water piping.
   2. Domestic hot water piping.
   3. Domestic hot water recirculating piping.
   4. Non potable water piping
   5. Sanitary and waste piping.
   6. Storm water piping.
   7. Vent piping.
   8. Insulated and non-insulated storm water piping.
   9. Natural gas piping.

C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Within 5 feet of each valve and control device.
   2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
   3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
   4. At access doors, manholes and similar access points which permit view of concealed piping.
   5. Within 5 feet of major equipment items and other points of origination and termination.
   6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets,

convenience and lawn-watering hose bibbs, and shut-off valves at plumbing fixtures and similar rough-in connections of end-use fixtures and units.

B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
   1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.05 CEILING TACK INSTALLATION

A. Install ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.06 PLUMBING EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   2. Meters, gauges, thermometers and similar units.
   3. Pumps
   4. Water heaters, tanks and pressure vessels.
   5. Strainers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
   1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
   2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION 220553

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SECTION 220700
PLUMBING INSULATION

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Piping Insulation.

B. Equipment Insulation.

1.02 RELATED REQUIREMENTS

A. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields and high-density insulation inserts.

1.03 DEFINITIONS

A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.

B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.

C. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.

D. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.

E. Exposed: Insulation that is visible from the occupied space.

F. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.

G. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.

H. NAIMA: North American Insulation Manufacturers Association

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation.

B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.

D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

B. 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.

C. Flame/Smoke Ratings: Provide composite plumbing 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 UL 723 or ASTM E84 (NFPA 255) method.
   1. Exception: Exterior plumbing insulation may have flame spread index of 75 and smoke developed index of 150.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS AND MATERIALS

2.01 PIPING INSULATION MATERIALS

A. Mineral Fiber (rock, slag, or glass):
   1. Manufacturers:
      a. CertainTeed Corp
      b. Knauf Insulation
      c. Johns Manville
      d. Owens Corning
   2. Insulation: ASTM C547, Type I or II, rigid mineral fiber, pre-formed for the application.
      a. K-value: ASTM C518 or C177, maximum 0.24 at 75 degrees F.
      b. Minimum Service Temperature: 0 degrees F
      c. Maximum Service Temperature: 850 degrees F for Type I, 1200 degrees F for Type II.
      d. Density: Between 3 to 6 pounds per cubic foot for Type I, between 6 to 8 pounds per cubic foot for Type II.

3. Factory Applied Jacket: ASTM C1136, Type I.
    a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms and self-sealing lap.
    b. Poly ASJ: Paper/Foil/Scrim with polymer coating, water vapor permeance of 0.01 perms and self-sealing lap.
    c. Color: White.

B. Calcium Silicate:
1. Manufacturers:
    a. CertainTeed Corp.
    b. Johns Manville.
    c. Knauf Insulation.
    d. Owens Corning.
2. Insulation: ASTM C533, Type I, rigid molded, asbestos free, pre-formed for the application.
    a. K-value: ASTM C335 or C518, maximum 0.45 at 200 degrees F.
    b. Minimum Service Temperature: 80 degrees F
    c. Maximum Service Temperature: 1200 degrees F.
    d. Density: Maximum 15 pounds per cubic feet.

C. Flexible Elastomeric:
1. Manufacturers:
    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. K-Flex USA.
2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
    a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
    b. Minimum Service Temperature: Minus 297 degrees F
    c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
3. Factory Applied Jacket:
    a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Jacket requirements in Part 3 of this specification for application of this jacket.

D. Field-Applied Jacket:
1. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
    a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
    b. Manufacturers:
        1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
        2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
        3) Or approved equal.
2. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:

Outer Insulation Diameter (in)	Minimum Aluminum Jacket Thickness, (in) Non-Rigid Insulation	Rigid Insulation
Finish		
≤ 8	0.016	0.016
Stucco		
< 12	0.020	0.016
Stucco		
≤ 24	0.024	0.016
Stucco		

a. Banding:
   1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
   2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.

3. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.

E. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02

Notes:
1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.
2. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.

G. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

H. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

I. High Density Insulation Billets:
   1. Calcium Silicate: ASTM C533 and C795.

J. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.

K. Pipe Insulation Accessories: Provide staples, Bands, Wires, and Cement and other appurtenances as recommended by insulation manufacturer for applications indicated.

L. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

M. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

N. High Density Insulation Billets:
   1. Cellular Glass: ASTM C552.

2.02 EQUIPMENT INSULATION MATERIALS

A. Flexible Mineral Fiber (rock, slag, or glass):
   1. Manufacturers:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
   2. Insulation: ASTM C553, Type I and II or ASTM C547 Type II, flexible mineral fiber blanket.
      a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
      b. Minimum Service Temperature: Minus 20 degrees F
      c. Maximum Service Temperature: 450 degrees F for ASTM C553 Types I and II, 1200 degrees F for ASTM C547 Type II.
      d. Density: Minimum 1.5 pounds per cubic foot.
   3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
      a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
      b. Color: White.

B. Rigid Mineral Fiber (rock, slag, or glass):
   1. Manufacturers:
      a. Johns Manville.
      b. Knauf Insulation.
      c. Owens Corning.
   2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
      a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
      b. Minimum Service Temperature: 0 degrees F
      c. Maximum Service Temperature: 450 degrees.

d. Density: Minimum 3.0 pounds per cubic foot.

3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
   a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
   b. Color: White.

C. Flexible Elastomeric:
1. Manufacturers:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. K-Flex USA.
2. Insulation: ASTM C534, Grade I or II, flexible elastomeric cellular rubber insulation, sheet form.
   a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
   b. Minimum Service Temperature: Minus 40 degrees F
   c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.

D. Field-Applied Jacket:
1. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
   a. Thickness: 0.032 inch sheet.
   b. Finish: Smooth.
   c. Joining: Longitudinal slip joints and 2 inch laps.
   d. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
2. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, and other appurtenances as recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coating, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
2. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Foster 30-80, Childers CP-38, Design Polymerics 3040, or equal.
3. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36. Childers CP-50AHV2 or equal.
4. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 PROTECTION AND REPLACEMENT

A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.

B. Repair existing plumbing insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.

C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.03 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's installation instructions.

B. Install in accordance with NAIMA National Insulation Standards.

3.04 PLUMBING PIPING SYSTEM INSULATION

A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Exposed Piping: Locate insulation and cover seams in least visible locations.

E. Cold Piping Insulation:
   1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
   2. Provide with factory applied vapor barrier jacket.
   3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers

and Supports for Plumbing Piping" for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.

4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Secure all-service jacket with self-sealing longitudinal laps.

F. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture infiltration.

G. Hot Piping Insulation:
1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Provide jackets without vapor barrier. Jackets with factory applied vapor barrier are allowed.
3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Secure all-service jacket with self-sealing longitudinal laps.
6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.

H. Exterior piping:
1. Encase exterior piping insulation with aluminum weather-proof jackets.
2. Insulate exterior cold waterand non-potable water piping as previously described.

3.05 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):
1. Application Requirements: Insulate the following cold equipment:
   a. Drip pans under chilled equipment.
   b. Roof drain bodies.
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: 2" thick for cold surfaces above 35 degrees F (2 degrees C) and 3" thick for surfaces 35 degrees F (2 degrees C) and lower.
   b. Flexible Elastomeric: 1" thick.

B. Hot Equipment (Above Ambient Temperature):
1. Application Requirements: Insulate the following hot equipment:
   a. Hot water storage tanks.
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: 2" thick, except 3" thick for steam-jacketed heat exchangers.
   b. Calcium Silicate: 3" thick.

c. Flexible Elastomeric: 1" thick for equipment operating up to 180 degrees F (82 degrees C).

3.06 INSTALLATION OF PIPING 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. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.

C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating.

F. Cold Pipe Insulation:
1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports.
3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section “Hangers and Supports for Plumbing Piping” for insulation shields.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

G. Hot Pipe Insulation:
1. Provide pipe hangers for hot piping sized for the outside diameter of piping.
2. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints. Seal exposed insulation at hanger with joint sealant.

H. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves (except balancing and flow control 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. Butt tightly against adjoining pieces and bond 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 elastomeric, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control 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.

I. 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.

J. 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 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.

K. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

L. Exterior Piping and Piping Exposed to Weather:
1. General: Provide piping jacket around insulation as scheduled in the Piping Jacket Schedule. Jacket material shall be approved by the jacket manufacturer for use with the specific insulation material that it covers. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.
2. Paintable Coating: After adhesive has fully cured, apply two coats of insulation manufacturer’s recommended protective coating.
3. Rigid Aluminum Shell: Space attachment bands 12 inches on center and directly centered over end joints.
4. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.

3.07 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breechings, or stacks while hot.

E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

3.08 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 remainder of construction period, to avoid damage and deterioration.

3.09 PIPING SYSTEM INSULATION SCHEDULE

A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.

B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.

C. Omit insulation on the following:
1. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.
2. Chrome-plated exposed piping
3. Water Hammer Arrestors
4. Balancing and flow valves
5. Drain lines from water coolers
6. Drainage piping located in crawl spaces or tunnels
7. Exterior condensate drain piping
8. Buried piping
9. Pre-insulated equipment.
10. Cold water piping
11. Condensate piping
12. Storm drainage piping
13. Overflow storm drainage piping

D. Exterior Piping Exposed to Weather: Insulate all exterior plumbing piping exposed to weather with:
1. Flexible elastomeric

E. Cold Piping (minimum operating temperature less than 60 degrees F.)
1. Service
   a. Potable cold water piping.
   b. Non-potable cold water piping
   c. Plumbing vents within 6 lineal feet of roof outlet.
   d. Horizontal interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
   e. Horizontal and vertical interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
   f. Horizontal and vertical interior above-ground overflow storm drainage piping and vertical run from roof drain to horizontal run. Where vertical overflow storm drainage piping from the outlet exceeds 15 feet, only insulate within 15 feet of the outlet.
   g. Condensate piping inside the building.
2. Insulate each piping system specified above with one of the following types of insulation.
   a. Mineral fiber.

F. Hot Temperature Piping (105 degrees to 180 degrees F (40 to 82 degrees C)):
1. Service:
a. Hot water supply and return piping.
2. Insulate each piping system specified above with one of the following types of insulation.
a. Mineral fiber.

3.10 PIPE INSULATION THICKNESS SCHEDULE

A. Piping Inside Masonry Wall Units:
1. Insulate cold, hot, and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:
a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2-1/2" to 6" (largest size permitted).

B. IECC – 2018 Requirements, Pipe Insulation

Minimum Pipe Insulation Thickness

Fluid Operating Temp. Range (°F) And Usage	Insulation Conductivity Conductivity, Btu·in./(hr·ft²·°F)	Mean Rating Temp., °F.	Nominal Pipe or Tube Size (in.) <1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness, in.				
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0

Notes:

a. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r[(1 + t/r)^{(K/k)} – 1]$ where
1) T = minimum insulation thickness (in.),
2) r = actual outside radius of pipe (in.),
3) t = insulation thickness listed in the table for applicable fluid temperature and pipe size,
4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in/hr·ft²·°F); and
5) k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

c. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.

d. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

C. ASHRAE 90.1 – 2016 Requirements, Pipe Insulation

Minimum Pipe Insulation Thickness

Fluid Operating Temp. Range (°F) And Usage	Insulation Conductivity Conductivity, Btu·in./(hr·ft²·°F)	Mean Rating Temp., °F.	Nominal Pipe or Tube Size (in.) <1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness, in.				
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.22–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0

Notes:

a. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)^{(K/k)} – 1\}$ where
   1) T = minimum insulation thickness (in.),
   2) r = actual outside radius of pipe (in.),
   3) t = insulation thickness listed in this table for applicable fluid temperature and pipe size,
   4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./hr·ft²·°F); and
   5) k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.

c. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote a) but not to a thickness less than 1 inch.

d. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

3.11 PIPING JACKET SCHEDULE

A. Exposed piping:
   1. All-service jacket.
   2. Poly ASJ jacket, painted with color per architect and paint per division 7.
   3. Semi-rigid PVC.

B. Piping within return air plenums:
   1. All-service jacket.

C. Exterior Piping Exposed to Weather
   1. Aluminum with stucco finish.
   2. Multilayer Laminate Vapor Barrier Cladding (flexible elastomeric only).

END OF SECTION 220700

SECTION 221100
WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.

B. Contractors Option:
1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined water distribution piping systems where used shall be provided in compliance with specification Section 221111 “Mechanically Joined Plumbing Piping Systems”.
2. The Division 22 contractor may provide PEX water distribution piping systems in lieu of, in whole or in part, for copper tube water distribution systems 2” and smaller. PEX water distribution piping systems are specified in Division 22 Section 221112 “PEX Water Distribution Piping and Specialties”.

C. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 11 Section “Kitchen and Food Service Equipment,” for faucets and valves furnished with the food service and kitchen equipment.
5. Division 22 Section "Identification for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
8. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
9. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
10. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
11. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties,” for material and methods for trap primer outlet piping.

D. Products installed but not furnished under this Section include water meters that will be provided by the utility company to the site and ready for installation. Coordinate with owner/tenant for the name and address of the utility company.

1.02 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
   1. Product data for each piping specialty and valve specified.
   2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
   3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
   4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
   5. Test reports specified in Part 3 of this Section.
   6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
      a. Hose bibbs
      b. Wall, yard, and roof hydrants
      c. Backflow preventers isolating irrigation or mechanical make-up systems
      d. Trap primers

1.04 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with the provisions of the following codes:
   1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
   2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.

C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.

D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.05 SPARE PARTS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flow Control Valves:
      a. Bell & Gosset, ITT
   2. Hose Bibbs with Vacuum Breaker:
      a. Zurn Industries Inc. Wilkins Regulator Div.
   3. Wall/Yard Hydrants:
      a. Woodford Mfg. Co.
   4. Backflow Preventers:
      a. Zurn Industries Inc. Wilkins Regulator Div.
   5. Pilot Operated Pressure-Reducing Valves:
      a. Watts Regulator Co.
   6. Piston Type Water Hammer Arresters:
      a. Precision Plumbing Products, Inc.
   7. Point of Use Thermostatic Mixing Valves
      a. Powers Process Controls
   8. Trap Primers and Distribution Units
      a. Precision Plumbing Products, Inc.
   9. Plumbing Pipe Support Brackets
      a. Holdrite
      b. PROFLO
      c. Sioux Chief
   10. Roof Hydrants
      a. Woodford Mfg. Co.

2.02 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or “Below Ground Water Distribution Pipe and Fittings”, for identification of systems where the materials listed below are used.

B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.

C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.

D. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.

E. PVC Plastic Service Pipe: AWWA C900, Class 100 Polyvinyl Chloride (PVC) water pipe, with belled-end fittings.

F. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.03 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.

B. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.

C. Ductile-Iron Gasketed Fittings: AWWA C153, 150 psi rating, with AWWA C104 cement mortar lining and AWWA C111 rubber gaskets.

D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.

E. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

F. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

2.04 JOINING MATERIALS

A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, Bag-7 Silver.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.05 GENERAL-DUTY VALVES

A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.06 SPECIAL DUTY VALVES

A. Flow Control Valves: 400 PSI WOG, 1 piece bronze, ball valve, with lead free cast bronze body meeting ASTM B584, handle, memory stop, with solder-end connections.

2.07 PIPING SPECIALTIES

A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.

B. Hose Bibbs (unfinished areas): Bronze body, renewable composition disc, tee handle, 1/2- or 3/4-inch solder inlet, hose outlet.

C. Hose Bibbs (finished areas): Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

D. Nonfreeze Wall Hydrants: As specified on the drawings.

E. Roof Hydrants: As specified on the drawings.

F. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.

G. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.

H. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

I. Point of Use Thermostatic Mixing Valves:
   1. Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.

J. Trap Primers: Brass construction, line pressure operation, capacity to prime number of traps as indicated with distribution units complying with requirements of ASSE Standard 1018.

K. Pipe Support Brackets:
   1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
   2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
   3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. PVC Service Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to prevent pipe deflection and then install subbase. Refer to Section

"General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

B. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

C. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.03 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.

B. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.

3.04 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.

B. Install cement-lined ductile-iron pipe with rubber gasketed joints, inside and outside under the building, for pipe 3 inches and larger.

C. Install AWWA C900 PVC service pipe with belled-end joints from 5'-0" outside the building.

3.05 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

I. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section “Common Work Results for Plumbing” for special sealers and materials.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods” for special sealers and materials.

M. Install piping with 1/32-inch-per-foot (1/4 percent) downward slope towards drain point.
    a. Install piping level with no pitch.

3.06 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:
    1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
    2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
    3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections “Supports and Anchors” and “Plumbing Insulation”.

4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
   a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste and vent pipe at each plumbing fixture.
9. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.
   a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
   b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
10. Provide roll hangers for individual horizontal runs 100 feet or longer.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.

D. Support water piping within 12” of each elbow or tee and for water piping 2-1/2” and larger at each valve or strainer.

E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.07 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
   1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
   2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
   3. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   2. Align threads at point of assembly.
   3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
   4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
      a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Provide dielectric waterway fittings for 2” and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section “Basic Piping Materials and Methods”.

F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

3.08 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in a separate section of Division 2.

B. Underground exterior water distribution piping to be a depth as required by local conditions, in accordance with authority having jurisdiction’s requirements and at depth no less than 18” below grade.

C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

D. Install sleeve and caulk at penetrations through building floor for watertight installation.

E. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge, and test tee with valve.

F. Ductile-Iron Pipe: Install in accordance with AWWA C-600. Pipe below ground inside building and to a point 5 feet outside of building shall have restrained joints.

G. Copper Pipe: Install Type K, soft annealed copper tube and brazed joints, with minimum number of joints, to a point 5 feet outside of building. Install changes of direction larger than the manufacturer recommended minimum bend radius to prevent kinks in the line.

3.09 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shut-off duty: Use gate, ball, and butterfly valves.

3.10 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.

F. Wall Hydrants: Install where indicated with vacuum breaker.

G. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet."

3.11 INSTALLATION OF FLOW CONTROL VALVES

A. Install flow control valves or automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.

B. Set flow control valve flow rate as follows:
   1. Preliminary Procedures For Hot Water Return System Balancing:
      a. Before operating the system perform these steps:
         1) Open valves at recirculation pump and flow control valves to full open position.
         2) Remove and clean all strainers.
         3) Check recirculation pump rotation.
         4) Set water heater temperature as indicated on the drawings.
   2. Procedures For Hot Water Return System Balancing
      a. Refer to the drawings for required flow rate for each flow control valve.
      b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
      c. Apply instrument as recommended by the manufacturer.
      d. Take readings with the eye at the level of the indicated value to prevent parallax.
      e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
      f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
   a. Valve tag number and description of location
   b. Valve body size
   c. Differential pressure reading from instrument in psi
   d. Actual flow rate derived from the manufacturer’s charts and tables for the valve size and measured differential pressure.

3.12 TRAP PRIMERS

A. Install trap primers where indicated and where required by local authorities having jurisdiction.

B. Connect trap primer supply line to the top of domestic cold water line no larger than 1-1/2” in diameter.

C. Provide trap primer distribution units for trap primers serving more than one trap.

D. Install trap primer distribution level to insure even water distribution unit to each circuit.

E. Where applicable, adjust the trap primer for proper flow.

F. Install trap primers a minimum of 12 inches above finished floor for every 20 feet of horizontal outlet piping to floor drains served.

G. Install trap primers in an accessible location.

H. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for trap primer outlet pipe requirements.

3.13 INSTALLATION OF PIPING SPECIALTIES

A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.

B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.14 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.15 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:
   1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
      a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
      b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
      c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
      d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.

B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
   1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
   2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.

3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.16 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:
1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
    a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
    c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
    d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
    e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.17 COMMISSIONING

A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.

B. Before operating the system, perform these steps:
1. Close drain valve, hydrants, and hose bibbs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings.

END OF SECTION 221100

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SECTION 221111
MECHANICALLY JOINED PLUMBING PIPING SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section only applies to Mechanically Joined Plumbing Piping Systems for joining piping for Plumbing applications as defined in Division Section 22 “Water Distribution Piping and Specialties”. Section includes:
   1. Copper grooved piping system
   2. Copper press piping systems

B. The Division 22 contractor may provide mechanically joined, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods.

C. Mechanically joined couplings, fittings, valves and related components specified in this section shall not be provided for natural gas piping in lieu of welded, threaded or flanged piping methods.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.03 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

B. CWP: Cold working pressure in psi.

C. CTS: Copper tube size.

1.04 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 22 section “Basic Plumbing Piping Materials and Methods” for materials for dielectric waterway fittings and flange kits.

B. Division 22 Section “Water Distribution Piping and Specialties” for related sections.

1.05 SUBMITTALS

A. Submit in accordance with conditions of Contract and Division 1 submittal procedures.

B. Product Data: Submit data for each type of coupling, fitting and special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing.

C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
   1. Indicate grooved-joint couplings and fittings on drawings and product submittals, and specifically identify with the applicable style or series designation.
   2. If an assembly of flexible couplings are used for seismic vibration, thermal expansion, or noise and vibration reduction, submit shop drawings indicating location of assembly, including anchors and guides. Include movement analysis of the assembly, and performance data of the assembly.

D. Maintenance Data: Include for each piping specialty and valve in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

E. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Failed test results and corrective action taken to achieve requirements.

F. Submit a schedule of dissimilar metal joints and adaptor flanges and flange kits. Include joint type material, connection method and proposed flange kits to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Dielectric flange kits are specified in Division 22 section “Basic Plumbing Piping Materials and Methods”.

G. Submit certification that valves and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

H. Submit certification that pipe, pipe fittings, pipe specialties, and valves and fittings are manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

I. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker’s training certificate of completion with closeout documents.

1.06 QUALITY ASSURANCE

A. All grooved and press to connect components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability.

B. Grooved mechanical piping shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-39.1, ASME, UL/ULC, FM, IAPMO or ICC.
   1. Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.1 and ANSI B31.9.

C. Grooved and press to connect end product manufacturer shall be ISO certified.

D. Grooved couplings shall meet the requirements of ASTM F-1476.

E. Grooving tools shall be of an approved manufacturer by the grooved fittings manufacturer. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.

F. Obtain training from the grooved and press to connect manufacturer for all workers that will be installing or handling the grooved or press to connect piping systems.

G. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves and fittings containing no more than 0.25% lead by weight for domestic water distribution.

H. Pipe, fittings, specialties, and valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI, and MSS standards.

1.07 COORDINATION

A. Reference Division 22 Section “Water Distribution Piping and Specialties” for coordination.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Refer to manufacturer’s current literature for comparable products and pressure ratings of couplings and standard fittings for various pipe sizes and pipe schedules. Products identified by model number are based on available size ranges from that manufacturer. Products offered by manufacturers with extended ranges are acceptable provided they meet the specified requirements.

B. Copper Grooved Copper Tubing System
1. Anvil International “Gruvlok”.
2. Grinnell Mechanical Products.
3. Shurjoint Piping Products.
4. Victaulic Company of America.

C. Press to Connect Copper Tubing System
1. Apollo “Press”
2. GRINNELL Mechanical Products “G-Press”
3. Mueller Streamline PRS
4. NIBCO Inc., Press System.
5. Viega ProPress

2.02 COPPER GROOVED TUBING SYSTEM

A. Pipe:
1. 2 inch through 8 inches: CTS, ASTM B88 Type L, hard drawn.
2. Ends: Roll grooved only in accordance to manufacturer’s current listed standards. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
3. Grooved mechanical piping shall conform to local code approval and/or as listed by ANSI-B31.9, ASME, UL/ULC, FM, IAPMO or ICC.
    a. Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.9.

B. General requirements for couplings, adapters, and standard fittings:
   1. Full-flow type, compatible with ASTM B75 or B88 CTS grooved joints.
   2. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.

C. Couplings:
   1. Meeting ASTM F1476 and constructed of two-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket, with pressure rating of 300 PSI at 180F. Provide washers where required by the manufacturer.
   2. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
   3. Rigid Type:
      a. ASC Engineered Solutions Gruvlok Series # 6402.
      b. Shurjoint Piping Products Styles #305, #306, and #307.
      c. Victaulic Style # 607.
   4. Bolts, nuts, and washers:
      a. Track-head bolts of heat treated carbon or manganese steel conforming to ASTM A183 or A449 with a minimum tensile strength of 110,000 psi.
      b. Heavy-duty hexagonal nuts conforming to ASTM A563, Grade B.
      c. Plated carbon steel flat washers conforming to ASTM F436.
      d. Zinc-electroplated conforming to ASTM B633.
      e. Type 304 or 316 stainless steel bolts and nuts conforming to ASTM A193, Grade B8/B8M, Class 2 or ASTM F593 and F594, Group 2, Condition CW.
      f. Type 304 or 316 stainless steel washers.

D. Flange Adapters:
   1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
   2. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
   3. 2 inch-6 inches (ANSI class 125/150):
      a. ASC Engineered Solutions Gruvlok Series # 6084.
      b. Shurjoint Piping Products Styles # C341.
      c. Victaulic Style # 641.

E. Fittings:
   1. Materials:
      a. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100.
      b. Lead free bronze sand cast conforming to ASTM B584 alloy UNS C89836.

F. Gaskets:
   1. EPDM Gaskets:
      a. Grade “E”, “EHP” or “EHT” EPDM compound (green or red/green color coded, respectively) conforming to ASTM D2000 designation 2CA615A25B24F17Z.
      b. Temperature operating range: -30 degrees F to +230 degrees F.
      c. Style suitable for the application.
   2. Fluoroelastomer Gaskets

a. Fluoroelastomer compound specifically formulated for compatibility with potable water systems resistant to chlorine and chloramine disinfectants (red and blue stripe color code).
b. Temperature operating range: 0 degrees F to +180 degrees F.
c. Style suitable for the application.

G. Valves:
1. Provide valves as specified in Division 22 section “General Duty Valves for Plumbing Piping.”

H. Adapters – Grooved X Plain Copper
1. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100. CTS grooved end x plain end for press or sweat connection.
a. ASC Engineered Solutions Gruvlok Series #652
b. Shurjoint #C52

2.03 PRESS TO CONNECT COPPER TUBING SYSTEM

A. Copper Tube:
1. CTS ½ inch through 4inch: ASTM B-88 Type K or L.

B. General requirements for couplings, adapters, and standard fittings:
1. Fittings shall meet ASTM F3226, ASME B16.51, ASME B31.9 and IAPMO PS-117 or ICC-ES IC 1002.
2. Acceptable body materials:
a. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C11000.
b. Lead free cast brass conforming to ASTM B584 alloy C87600.
3. Coupling and fitting housings with soldered ends shall conform to ASME B16.18 and B16.22.
4. Coupling and fitting housings with flared ends shall conform to ASME B16.26.
5. Coupling and fitting housings with threaded ends shall conform to ASME B1.20.1.
6. Coupling and fitting housings for press ends shall have self-contained O-ring seals in the coupling/fitting ends.
7. Rated for 200 psi CWP up to 250 degrees F maximum.
8. Press to connect fittings shall have leak feature integral to the fitting body to detect unpressed fittings during pressure testing.

C. O-Ring Seals: EPDM compound conforming to ASME B16.51, style suitable for the application.

D. Flange Adapters:
1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
2. 2-1/2 inch through 4 inches (ANSI class 125/150):
a. Steel flange with NSF 14 compliant fused epoxy coating, copper or brass press to connect joint with copper face ring and plastic or rubber dielectric isolating ring separating the flange from the press to connect joint.
3. Rated for 200 psi CWP up to 250 degrees F maximum.

E. Valves:

1. Provide 2 inch and smaller press to connect valves listed in this section or lead-free cast bronze valves 2 inch and smaller listed in Division 22 section “Water Distribution Piping and Specialties” may be used with sweat connections or sweat X press adapters.
2. Ball Valve:
    a. Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
    b. Body and trim: Lead free cast bronze conforming to ASTM B62 or B584.
    c. Ends: Female press to connect ends of copper material.
    d. Ball: Full port, chrome-plated brass ball.
    e. Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
    f. Seat: PTFE or TFE, suitable for intended service.
    g. Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2-inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.
        1) Apollo # 77WLF
        2) NIBCO # PC-585-LF
        3) Milwaukee # UPBA-450-12
3. Ball Valve:
    a. Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
    b. Body and trim: Lead free cast bronze conforming to ASTM B62 or B584.
    c. Ends: Female press to connect ends of copper material.
    d. Ball: Full port, stainless steel ball.
    e. Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
    f. Seat: PTFE or TFE, suitable for intended service.
    g. Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2-inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.
    h. 2 inch and smaller:
        1) Apollo # 77WLF-140
        2) NIBCO # PC-585-66-LF
        3) Milwaukee # UPBA-450S-12
        4) Viega # 2971.1 ZL
4. Gate Valves
    a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    b. Body and trim: Lead free cast bronze body conforming to B584 with threaded bonnet and solid wedge.
    c. Ends: Female press to connect ends of copper or brass material.
    d. Stem: Silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel, rising type with brass packing gland and non-asbestos packing.
    e. Operator: Malleable or ductile iron hand-wheel.
    f. 2 inch and smaller:
        1) Apollo # 101T-PRLF
        2) Hammond # UP645 P2
        3) Milwaukee UP105 P2
        4) NIBCO # PC-113-LF
5. Globe Valves
    a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
    b. Body and trim: Lead free cast bronze conforming to B584 with threaded bonnet.

c. Disc: PTFE renewable seat and disc.
d. Ends: Female press to connect ends of copper or brass material.
e. Stem: Silicon bronze conforming to ASTM B 99, or stainless steel, rising type with brass packing gland and non-asbestos composition packing.
f. Operator: Malleable or ductile iron hand-wheel.
g. 2 inch and smaller:
1) Apollo # 120T-PRLF
2) Hammond # UP440 P2
3) Milwaukee # UP502 P2

6. Check Valves (Y pattern, swing type or in-line)
a. Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b. Body and trim: Cast bronze conforming to ASTM B62.
c. Disc: PTFE renewable seat and disc.
d. Ends: Female press to connect ends of copper or brass material.
e. 2 inch and smaller:
1) Apollo # 163T-PRLF
2) Hammond # UP904 P2
3) NIBCO # PF-413-Y-LF
4) Milwaukee # UP509 P2

7. Check Valves (lift type, in-line)
a. Rated for 250 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b. Body: Cast bronze conforming to ASTM B584.
c. Spring: 316 stainless steel.
d. Ends: Female press to connect ends of copper or brass material.
e. 2 inch and smaller:
1) Apollo # 61LF
2) Milwaukee # UP548T P2

8. Gate Valves -2-1/2 inch and Larger
a. MSS SP-70; Class 125, 200-psi CWP, iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly. Provide with factory installed press to connect flange adapters, as described herein, with bolts, nuts and washers.
1) NIBCO

F. Strainers:
1. Provide 2 inch and smaller press to connect strainers listed in this section or lead free cast bronze strainers 2 inch and smaller listed in Division 22 section “Basic Piping Materials and Methods” may be used with sweat connections or sweat X press adapters.
2. Strainers (Y pattern)
a. Rated for 250 psig CWP up to 250 degrees F maximum.
b. Body: Cast bronze conforming to ASTM B584.
c. Screen: Stainless steel mesh with 0.062” perforations.
d. Ends: Female press to connect ends of copper or brass material.
e. 2 inch and smaller:
1) Apollo # 59LF

PART 3 EXECUTION

3.01 PIPING INSTALLATIONS

A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

B. Water distribution piping installations shall be installed subject to Division 22 Section "Water Distribution Systems and Specialties" in addition to those requirements specified in this Section.

C. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

3.02 PIPE APPLICATIONS ABOVE GRADE

A. Water piping in sizes 2-1/2 to 8 inches shall be Type L drawn copper tube with roll-grooved ends and copper tube dimensioned mechanical couplings and fittings or water piping sizes 2-1/2 inch to 4 inch shall be Type L drawn copper tube with plain ends and copper tube dimensioned press to connect fittings.

B. Water piping in sizes 2 inches and smaller shall be Type L drawn copper tube with plain ends and copper tube dimensioned press to connect copper couplings and fittings.

3.03 HANGERS AND SUPPORTS

A. Support of piping must account for expansion and contraction, vibration, and the dead load of the piping and its contents.

B. General: Hanger supports, and anchors devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping." Reference Division 22 Section "Water Distribution Systems and Specialties" for pipe spacing limitations.

3.04 PIPE JOINT CONSTRUCTION

A. Copper Grooved tubing System
   1. Pipe ends shall be clean and free from oils, indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing.
   2. Roll and cut groove ends in accordance to manufacturer's current listed standards. Use rolls sets designed and intended for use on the appropriate pipe material when grooving pipe.
   3. Flaring of CTS tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
   4. Verify the gasket style and elastomeric material (grade) is suitable for the intended service as specified and in combination with any system chemical additive.
   5. Reference latest published manufacturer's product data for additional pressure ratings and application information.
   6. Reference latest published manufacturer's field installation instructions or other included installation instruction prior to attempting assembly.

7. Ream, deburr and clean tube ends and verify they are free from indentations, projections and roll marks in the area from tube end to groove for proper gasket sealing.
8. All grooved components (couplings, fittings, valves, gaskets, bolts and nuts) shall be of one manufacturer. All grooving tools shall be of one manufacturer, though not necessarily the same as the grooved component manufacturer.
9. Install gaskets with lubricant suitable for all piping services. Lubricant shall be by one manufacturer.

B. Press to connect Copper Tubing System
1. Ream, deburr and clean tube ends and verify they are free from indentations, projections, burrs and foreign matter.
2. Install permanent inspection mark on tube.
3. Clean tube and fittings of all dirt and oil. Verify O-ring is in place and free of oil, grease or dirt.
4. Push copper tube into fittings with twisting action to all the way to the fitting stop or shoulder.
5. Mark tube with permanent marker to indicate proper tube insertion depth.
6. Verify press tool has correct size jaw set for tube size used.
7. Complete one tool cycle with empty jaw to calibrate tool for each time new jaw is inserted into tool.
8. Squeeze jaw arms to open tool jaws and place jaws around the contour of the fitting. Verify tool is perpendicular to the fitting and depress tool switch.
9. Squeeze jaw open to remove the tool and observe witness mark.
10. Verify crimped fitting connection for misalignment of the copper tube, misalignment of the tool or improper insertion of the tube. If any of these conditions are found cut out the joint and provide a new joint.
11. Maintain minimum distance between joints per the manufacturer's published installation instructions.
12. Perform pressure test for unpressed fitting detection per manufacturer's installation instruction prior to final pressure test.

C. Dielectric Isolation Requirements for Copper Grooved Connections: Provide dielectric grooved waterway fittings or couplings at grooved galvanized steel, stainless steel or ductile iron to grooved copper joints. Dielectric waterway fittings are specified in Section "Basic Piping Materials and Methods".

D. Dielectric Isolation Requirements for Press to Connect Adapter Flange Connections: Provide dielectric flanges or flange kits for the following joint types:
1. Adapter Flanges to Iron, Ductile Iron or Steel Body Valves and Fittings (Except Butterfly Valves with EPDM Sleeve/Seats): Provide full face gaskets between flanges and adapter flanges. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on valve and adapter flanges.
2. Full face gaskets, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves are specified in Section "Basic Piping Materials and Methods".

E. Flange Adapters:
1. Install flange adapter washers when flange adapters are used against the following surfaces:
a. Rubber.

b. Adapting to ANSI/AWWA cast flanges.
c. Rubber faced lug valves.
d. Serrated flanged surfaces.

2. Do not install flange adapters for applications that incorporate tie rods for anchoring or on standard grooved-end fittings within 90 degrees of each other.

3.05 VALVE APPLICATIONS

A. Reference Division 22 Section “Water Distribution Piping and Specialties” for valve applications.

3.06 EQUIPMENT CONNECTIONS

A. Grooved flexible style couplings may be used at equipment connections where specified for vibration isolation control only.

B. Press to connect joints shall not be provided for equipment connections. Provide flanges, unions, di-electric unions or waterway fittings. Flanges, unions, di-electric unions and waterway fittings are specified in Division 22 specification section “Basic Piping Materials and Methods”

3.07 EXPANSION JOINTS:

A. Provide expansion joints where indicated. Expansion joints and their installation requirements are specified in Division 22 specification section “Expansion Fittings and Loops for Plumbing Piping”.
1. Provide with copper press to connect ends or copper press to connect X screwed NPT adapters for 2 inches and smaller.
2. Provide with copper press to connect ends or press to connect adapter flanges for 2-1/2 inches to 4 inches.
3. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

B. Where field conditions allow and as a contractor’s option, provide expansion joints consisting of an assembly of flexible couplings: Fabricated from a combination of couplings and nipples with rolled groove short type “K” or “L” copper tube nipples and flexible CTS couplings. Install with removable ties to hold joint compressed or expanded during piping fabrication. Provide the same gaskets as specified above for rigid couplings. Provide expansion joints of an assembly of flexible couplings with displacement identical expansion joints as indicated.

3.08 STRAINERS

A. Provide strainers as specified in part 2 of this specification section or Division 22 specification section “Basic Piping Materials and Methods”.
1. Provide manufacturer strainer with press to connect ends for 2 inches and smaller.
2. Provide copper press to connect X screwed NPT adapters for 2 inches and smaller.
3. Provide press to connect adapter flanges for 2-1/2 inches to 4 inches.
4. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

3.09 WATER DISTRIBUTION SPECIALTIES INSTALLATION

A. Reference Division 22 Section “Water Distribution Systems and Specialties” for water distribution specialties and installation requirements.

3.10 FIELD QUALITY CONTROL

A. The following procedures are paraphrased from the ASME B-31.9, code for pressure piping, building services piping.

B. Installing contractor shall schedule certification training session with the mechanically joined piping component manufacturer, or manufacturer’s representative, for all workers that will be installing or handling the mechanically joined piping systems Training shall cover the proper use of mechanically joining tools and installation of mechanically joined piping products. Mechanically joined piping component manufacturer, or manufacturer’s representative shall provide a certificate of completion for each attending worker.

C. Provide testing procedures as defined in Division 22 Section “Water Distribution Systems and Specialties” and as specified in mechanically joined piping component manufacturer’s installation instructions.

D. Installing contractor shall visually inspect couplings and repair or replace any misaligned couplings and couplings with gaps prior to calling for inspection as defined in Division 22 Section “General Plumbing Requirements.”

E. Mechanically joined piping component manufacturer’s representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer’s field installation instructions and best practice procedures provided during the training session.

F. Workers performing mechanically joined joints shall initial each joint with a permanent ink marker, such as a “Sharpie”. Initials shall be block letters with a minimum height of 1/4”.

3.11 STARTUP

A. Refer to Division 22 Section “Water Distribution Piping and Specialties” for startup procedures.

END OF SECTION 221111

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SECTION 221112
PEX WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes PEX tubing, fittings and specialties for domestic cold water, hot water, and hot water recirculation distribution within the living units of the building.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
2. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall penetrations.
4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors and mechanical sleeve seals.
5. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials and methods for hanging and supporting water distribution piping.
6. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
7. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
8. Division 22 Section “Water Distribution Piping and Specialties” for stainless steel tubing for water distribution piping.

1.02 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Pipe sizes used in this Specification are nominal pipe size (NPS).

C. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content less than or equal to 0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:
1. ASTM E84 - Surface Burning Characteristics of Building Materials.
2. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing
3. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
4. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing

5. ASTM D6394 Specification for Sulfone Plastics (SP)
6. ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials
7. ANSI/NSF Standard 61 Drinking Water System Components - Health Effects
8. ASTM F1807 Standard Specification for Insert Fittings with PEX Reinforcing Rings for use with Cross-linked Polyethylene (PEX) Tubing
9. Plastics Pipe Institute (PPI) Technical Report TR-4/06
10. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of brass or bronze fittings containing no more than 0.25% lead by weight for domestic water distribution.
11. Comply with the manufacturer's installation guide for installation of PEX tubing, including methods for dealing with thermal expansion.
    a. Uponor Professional Plumbing Installation Guide, 2010
    b. Uponor Plumbing Design Assistance Manual, 2008

B. PEX tubing and fittings shall be by one manufacturer assembled with the manufacturer's approved crimping tools.

C. Comply with NSF 61 Annex G for wetted surfaces of fittings containing less than or equal to 0.25% lead by weight compliance for use in domestic water service.

D. Obtain training from the PEX tubing manufacturer for all workers that will be installing or handling the PEX tubing systems.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
1. Product data for each tubing specialty and valve specified.
2. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
3. Maintenance data for each tubing specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
4. Test reports specified in Part 3 of this Section.

B. Submit third party certification that fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

C. Tubing and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

D. 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."

E. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker's training certificate of completion with closeout documents.

1.05 COORDINATION

A. Reference Division 22 Section “Water Distribution Piping and Specialties” for coordination.

1.06 SPARE PARTS

A. Maintenance Stock: Furnish the following for each system component:
   1. One complete crimping/expander tool set with crimp dies for each pipe size.
   2. One tube cutter.
   3. (6) fittings, tees, els and couplings and required number of crimp rings for all installed pipe sizes

1.07 WARRANTY

A. Piping system warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.

B. Manufacturer system warranty shall cover pipe and fittings for a duration of 25 years, from the date of installation.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Manifolds & Fittings:
      a. Uponor, Inc. with no substitutions
   2. Plumbing Pipe Support Brackets
      a. Holdrite
      b. Sioux Chief
   3. Cold Expansion Polyethylene Cross-Linked (PEX) Tubing System
      a. Uponor, Inc. with no substitutions

2.02 TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Article "Pipe Applications", for identification of systems where the materials listed below are used.

B. Cold Expansion PEX Tube: ASTM F876 and F877, SDR 9 PEX Water Tube with a pressure rating of 160psi at 73°F and blue or red color coded. Manufactured utilizing the PEX “A” method. NSF 14 certified and NSF 61 listed.
   1. PEX tube for hot water and hot water return shall be marked “5206”.
   2. Factory vinyl or polyethylene corrugated sleeve for PEX tubing for underground installation.

2.03 FITTING MATERIALS

A. Cold-expansion fittings: Meeting ASTM F1960, NSF 14 certified and NSF 61 listed, with internal diameter identical to PEX tubing sizes and manufactured from the following material types:
   1. 20% glass-filled polysulfone meeting ASTM D6394
   2. Lead-free Brass meeting ASTM B84.
   3. Reinforcing cold-expansion rings: Manufactured from the same source as PEX “A” tubing and marked “F1960”.

B. Stub Out Els: Square “O” strap ASTM B 88 type “L” line size copper tube with 90° bend and line size cold expansion PEX hose barb inlet.

2.04 PIPE SUPPORT BRACKETS:

A. Sheet Stud Bracket: 20-gauge copper with nominal copper tube holes of holes of ¾” or 1” on 4” centers.

B. Pipe Mounted Bracket: 20-gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.

2.05 GENERAL-DUTY VALVES

A. General-duty valves 2” and smaller (i.e., gate, globe, check and ball valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Provide valves of make and model specified in Division 22 Section "General Duty Valves for Plumbing Piping" with factory PEX hose barbs.

B. Special duty valves (i.e. T & P, flow control, pressure reducing and thermostatic mixing valves) are specified are specified in Division 22 Section "Water Distribution Pipe and Specialties.”

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install tubing and specialties in accordance with manufacturer’s installation instructions.

3.02 STORAGE AND PROTECTION

A. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

B. Store PEX piping in original packaging or under cover to avoid dirt or foreign material from being introduced into the piping.

C. Do not expose PEX piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

3.03 PIPE APPLICATIONS

A. Install PEX tubing for hot and cold-water copper tube sizes 2-1/2" and smaller. Maximum allowable fluid velocity is 8 feet per second. Provide equivalent SDR 9 PEX tubing nominal diameter to copper type "L" tube nominal (to provide equivalent internal diameters) as shown on the drawings:

Type "L" copper Tube Size (inches)	SDR 9 PEX Tubing Size (inches)
1	1-1/4
1-1/4	1-1/2
1-1/2	2
2	3
2-1/2	3

B. Install PEX tubing for under slab cold, hot and hot water recirculation water piping with one continuous piece of PEX tubing with no joints from the shutoff valve above grade to the shutoff valve at the fixture served. Provide cold water piping with factory vinyl or polyethylene sleeve at penetration of concrete slab. Provide 1" thick flexible elastomeric insulation for under slab hot and hot water recirculation piping. Provide 1" thick flexible elastomeric insulation at cold water slab penetration, length of slab penetration. Flexible elastomeric insulation and installation requirements are specified in Division 22 specification section "Plumbing Insulation".

C. Install type "L" copper tube at the inlet and outlet of the water heater, minimum 18" long. Refer to Division 22 Section "Water Distribution Piping and Specialties" copper tubing.

D. Install PEX tubing meeting ASTM E84 for 25 / 50 smoke flame rating per manufacturer's installation instructions inside return air plenums.

E. Install PEX tube listed to NSF-pw (CL5) chlorine resistance rating and marked "5306" for hot water and hot water return systems.

F. Install copper tubing for hot water piping operating in excess of 140ºF. Refer to Division 22 Section "Water Distribution Piping and Specialties" copper tubing.

3.04 TUBING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the tubing systems. Location and arrangement of tubing layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install tubing as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install tubing at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, unless indicated to be exposed to view.

E. Install horizontal tubing as high as possible allowing for proper slope and coordination with other components. Install vertical tubing tight to columns or walls. Provide space to permit insulation

applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install tubing in a manner to prevent stress from thermal expansion with 12” wide offsets in straight runs over 20’ or with loops with diameters not less than 8 tube diameters.

H. Install nailing plate over all stud penetrations of studs.

I. Install tubing level with no pitch.

J. Install tubing at rough-in for plumbing fixtures with stub out els.

K. Install manifolds with line size bodies above ceilings in an accessible location where indicated on the drawings with hot water on the left and cold water on the right. Provide access doors for manifolds.

L. Install blue tubing for cold water and red tubing for hot or hot water recirculation.

M. Install PEX tubing at a minimum of 12” away from recessed light fixtures.

N. Install PEX tubing below slab with manufacturer’s factory protective vinyl or polyethylene sleeve, full length and provide polyethylene shrink wrap over brass fittings.

O. Install PEX tubing from underground thru slab with manufacturer’s factory protective vinyl or polyethylene sleeve, thru full length to 6” below and above slab.

P. Provide line size stub out els at each fixture rough-in.
   1. Secure stub out els at rough-in for individual fixtures with sheet stud brackets attached to the wall studs.
   2. Secure stub out els at rough-in for flush valve fixtures with wood backboards attached to the wall studs.

Q. Connect PEX tubing to schedule 40 PVC pipe with PVC X PEX hose barb adapters.

R. Install PEX tubing, hangers, fittings and adapters, and provide recommended methods for controlling thermal expansion in hot water piping for straight runs every 50’ per the Plastics Pipe Institute (PPI) “Residential PEX Water Supply Plumbing Systems Design Guide” and the appropriate installation guide of the installed PEX manufacturer.

3.05 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to manufacturers published recommendations. Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:
   1. Clamps designed specifically for use with PEX tubing for installation inside walls.
   2. Pipe insulators designed specifically for use with PEX tubing.
   3. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs of insulated PEX tubing.

4. Plastic coated adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs of uninsulated PEX tubing.
5. Plastic coated riser clamps, MSS SP-69 Type 8, for individual vertical runs bearing on uninsulated PEX tubing.
6. Insulation protection shields and high-density insulation at each hanger for insulated pipe as specified in Division 22 Sections “Supports and Anchors” and “Plumbing Insulation”.

C. Install hangers for unsupported horizontal tubing every 32” with 3/8” rods.

D. Provide riser clamps every 6’-0” for vertical PEX tubing.

E. Provide clamps, specifically designed for use with PEX tubing, every 6’-0” for installation inside walls.

F. Contractor’s option: Provide “vee bottom” clevis hangers and “vee” plastic pipe support channels of 18-gauge galvanized steel to support horizontal runs of PEX tubing. Provide hangers spaced every 8’-0” with 3/8” rods.

G. Support water tubing within 12” of each elbow, tee or stub out el.

3.06 PIPE AND TUBE JOINT CONSTRUCTION

A. Tubing Joints: Comply with the manufacturer’s published installation instructions and use installation tools and materials by one manufacturer only – do not mix different manufacturers tools and materials.

3.07 INSULATION

A. Insulate hot water and hot water return piping as specified in Division 22 Section “Plumbing Insulation.” Cold water piping need not be insulated.

3.08 INSTALLATION OF VALVES

A. Installation of general duty valves is specified in Division 22 Section "General Duty Valves for Plumbing Piping."

B. Installation of special duty valves is specified in Division 22 Section "Water Distribution Pipe and Specialties.”

3.09 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution tubing as follows:
1. Do not enclose, cover, or put into operation water distribution tubing system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
    a. Rough-in Inspection: Arrange for inspection of the tubing system before concealed or closed in after system is roughed in and prior to setting fixtures.

b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
c. Reinspections: Whenever the plumbing official finds that the tubing system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.

B. Tubing System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
1. Test for leaks and defects all new water distribution tubing systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution tubing until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the tubing system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the tubing system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.10 FIELD QUALITY CONTROL

A. Installing contractor shall schedule training session with the PEX tubing manufacturer at project site for all workers that will be installing or handling the PEX tubing systems. Submit certification letter along with list of attendees to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.

B. PEX tubing manufacturer shall provide certification training to contractor without cost and without additional cost to Owner.

C. Provide testing procedures as defined in Division 22 Section “Water Distribution Systems and Specialties” and as specified in grooved mechanical piping manufacturer’s installation instructions.

D. Installing contractor shall visually inspect PEX tubing and joints and repair or replace any misaligned joints with gaps prior to calling for inspection as defined in Division 22 Section “General Plumbing Requirements.”

E. PEX tubing manufacturer’s representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer’s

field installation instructions and best practice procedures provided during the job-site training session.

END OF SECTION 221112

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SECTION 221118
PEX TUBING AND SPECIALTIES FOR RO AND ROR SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes PEX tubing, fittings and specialties for RO and ROR process water distribution piping only.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
2. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall penetrations.
4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors and mechanical sleeve seals.
5. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials and methods for hanging and supporting water distribution piping.
6. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.

1.02 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water filtration system to the points of usage.

B. Pipe sizes used in this Specification are nominal pipe size (NPS).

C. RO – reverse osmosis treated water

D. ROR – remineralized reverse osmosis treated water – RO water routed thru a “calcite filter” with proprietary calcite blend.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:
1. ASTM E84 Surface Burning Characteristics of Building Materials.
2. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing
3. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
4. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing
5. ASTM D6394 Specification for Sulfone Plastics (SP)
6. ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials
7. ANSI/NSF Standard 61 Drinking Water System Components - Health Effects

8. ASTM F1807 Standard Specification for Insert Fittings with PEX Reinforcing Rings for use with Cross-linked Polyethylene (PEX) Tubing
9. Plastics Pipe Institute (PPI) Technical Report TR-4/06
10. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of brass or bronze fittings containing no more than 0.25% lead by weight for domestic water distribution.
11. Comply with the manufacturer's installation guide for installation of PEX tubing, including methods for dealing with thermal expansion.
    a. Uponor Professional Plumbing Installation Guide, 2010
    b. Uponor Plumbing Design Assistance Manual, 2008

B. Obtain installation training from the PEX manufacturer for all workers that will be installing or handling the PEX piping systems. Submit certification letter along with each workers certificate of completion to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
1. Product data for each tubing specialty and valve specified.
2. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
3. Maintenance data for each tubing specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
4. Test reports specified in Part 3 of this Section.

B. Tubing and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

C. Submit contractor certificates indicating completion of PEX installation training course from manufacturer of piping to be used.

D. 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."

E. Submit training certificate of completion for each worker to engineer of record within 30-days of mobilization. Include copy of each worker's training certificate of completion with closeout documents.

1.05 SPARE PARTS

A. Maintenance Stock: Furnish the following for each system component:
1. One complete crimping/expander tool set with crimp dies for each pipe size.
2. One tube cutter.
3. (6) fittings, tees, els and couplings and required number of crimp rings for all installed pipe sizes

1.06 WARRANTY

A. Piping system warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.

B. Manufacturer system warranty shall cover pipe and fittings for a duration of 25 years, from the date of installation.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. PEX Tube Support Brackets
      a. Holdrite
      b. Sioux Chief
   2. Polyethylene Cross-Linked (PEX) Tubing System
      a. Uponor, Inc. with no substitutions

2.02 TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Article "Pipe Applications", for identification of systems where the materials listed below are used.

B. PEX Tube: ASTM F876 and F877, SDR 9 PEX Water Tube with a pressure rating of 160psi at 73°F and blue or red color coded. Manufactured utilizing the PEX “A” method. NSF 14 certified and NSF 61 listed.
   1. Factory vinyl or polyethylene corrugated sleeve for PEX tubing for underground installation.

2.03 FITTING MATERIALS

A. Cold-expansion fittings: Meeting ASTM F1960, NSF 14 certified and NSF 61 listed with internal diameter identical to PEX tubing sizes and manufactured from the following material types:
   1. 20% glass-filled polysulfone meeting ASTM D6394

2.04 PEX TUBE SUPPORT BRACKETS:

A. Sheet Stud Bracket: Galvanized steel bracket with holes for PEX tube isolators on 2” centers.

B. Pipe Mounted Bracket: Galvanized steel bracket with holes for PEX tube isolators for securing PEX tube and stainless-steel hose clamp for securing bracket to vertical waste and vent pipe in wall.

C. PEX Tube Bend Supports: Nylon 90-degree support with nail holes for connection to wall studs or outlet for connection to sheet stud or pipe mount brackets.

2.05 GENERAL-DUTY VALVES RO AND ROR WATER

A. Ball Valves: CPVC meeting ASTM 1784 with a cell class of 23567A one-piece valve body type with full port ball, CPVC stem and ABS handle and EPDM O-ring with socket weld joints and PEX hose barbs as required. Pressure rating of 150 psi @ 70F. NSF 61 certified. Manufactured by:
   1. ASAHI America #OMNI T-27

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install tubing, fittings valves and specialties in accordance with manufacturer's installation instructions.

3.02 STORAGE AND PROTECTION

A. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

B. Store PEX piping in original packaging or under cover to avoid dirt or foreign material from being introduced into the piping.

C. Do not expose PEX piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

3.03 PIPE APPLICATIONS

A. Install PEX tubing for RO and ROR piping 1" and smaller. Maximum allowable fluid velocity is 8 feet per second.

B. Install PEX tubing meeting ASTM E84 for 25 / 50 smoke flame rating per manufacturer's installation instructions inside return air plenums.

3.04 TUBING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the tubing systems. Location and arrangement of tubing layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install tubing as indicated.

B. Use fittings for all changes in direction and branch connections. Or use tube bends with minimum radius per pipe size per the manufacturer's installation guide.

C. Install tubing at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, unless indicated to be exposed to view.

E. Install horizontal tubing as high as possible allowing for proper slope and coordination with other components. Install vertical tubing tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit servicing of valves.

G. Install tubing in a manner to prevent stress from thermal expansion with 12” wide offsets in straight runs over 20’ or with loops with diameters not less then 8 tube diameters.

H. Install nailing plate over all stud penetrations of studs.

I. Install tubing level with no pitch.

J. Install tubing at rough-in for plumbing fixtures with stub out els.

K. Install PEX tubing at a minimum of 12” away from recessed light fixtures.

L. Install PEX tubing below slab with manufacturer’s factory protective vinyl or polyethylene sleeve, full length and provide polyethylene shrink wrap over brass fittings.

M. Install PEX tubing from underground thru slab with manufacturer’s factory protective vinyl or polyethylene sleeve, thru full length to 6” below and above slab.

N. Extend PEX tubing to 6” out of wall and cap at each equipment rough-in.
   1. Secure stub outs at rough-in for individual equipment with PEX tube bend supports attached to the wall studs.

O. Install PEX tubing, hangers, fittings and adapters, and provide recommended methods for controlling thermal expansion in hot water piping for straight runs every 50’ per the manufacturer’s installation guide.

P. Install PEX tubing connections to equipment with PEX hose barbs and shutoff valve.

3.05 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields and anchor components and installation procedures conforming to manufacturers published recommendations. Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:
   1. Clamps designed specifically for use with PEX tubing for installation inside walls.
   2. Pipe insulators designed specifically for use with PEX tubing.
   3. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs of insulated PEX tubing and PVC pressure pipe.
   4. Plastic coated adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs of uninsulated PEX tubing.
   5. Plastic coated riser clamps, MSS SP-69 Type 8, for individual vertical runs bearing on uninsulated PEX tubing and PVC pressure pipe.
   6. Insulation protection shields and high-density insulation at each hanger for insulated pipe as specified in Division 22 Sections “Supports and Anchors” and “Plumbing Insulation”.

C. Install hangers for unsupported horizontal tubing every 32” with 3/8” rods.

D. Provide riser clamps every 6’-0” for vertical PEX tubing.

E. Provide clamps, specifically designed for use with PEX tubing, every 6’-0” for installation inside walls.

F. Support water tubing within 12” of each elbow or tee.
   1. Support all sizes of horizontal of PVC piping every four feet.
   2. Support all sizes of vertical of PVC piping every floor, but not to exceed fifteen feet.

3.06 TUBE JOINT CONSTRUCTION

A. Tubing Joints: Comply with the manufacturer’s published installation instructions and use installation tools and materials by one manufacturer only – do not mix different manufacturers tools and materials.

3.07 INSULATION

A. Cold water piping need not be insulated.

3.08 INSTALLATION OF VALVES

A. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item.

3.09 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution tubing as follows:
   1. Do not enclose, cover, or put into operation water distribution tubing system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
      a. Rough-in Inspection: Arrange for inspection of the tubing system before concealed or closed in after system is roughed in and prior to setting fixtures.
      b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
      c. Reinspections: Whenever the plumbing official finds that the tubing system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
      d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.

B. Tubing System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
   1. Test for leaks and defects all new water distribution tubing systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution tubing until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the tubing system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the tubing system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.10 FIELD QUALITY CONTROL

A. Installing contractor shall schedule training session with the PEX tubing manufacturer at project site for all workers that will be installing or handling the PEX tubing systems.

B. PEX tubing manufacturer shall provide certification training to contractor without cost and without additional cost to Owner. PEX manufacturer shall provide a certificate letter stating the time, date and location of the training. PEX piping manufacturer shall provide a certificate of completion to each worker. Contractor shall keep each worker's certificate on site at all times.

C. Provide testing procedures as defined in Division 22 Section "Water Distribution Systems and Specialties" and as specified in grooved mechanical piping manufacturer's installation instructions.

D. Installing contractor shall visually inspect PEX tubing and joints and repair or replace any misaligned joints with gaps prior to calling for inspection as defined in Division 22 Section "General Plumbing Requirements."

E. PEX tubing manufacturer's representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer's field installation instructions and best practice procedures provided during the job-site training session.

END OF SECTION 221118

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SECTION 221123
DOMESTIC WATER PUMPS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:
   1. Inline circulator pumps

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
   2. Division 22 Section, “Basic Piping Materials and Methods” for rubber flexible connectors.
   3. Division 26 Section “Common Work Results for Electrical” required electrical devices.
   4. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
   1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
   2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
   3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
   4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
   5. Submit certification that pumps, valves, fittings and specialties comply with NSF 61 Annex G.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."

D. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

E. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

H. Comply with NSF 61 Annex G (pending) for wetted surfaces of valves, fittings and specialties containing no more than 0.25% lead by weight compliance for valves for domestic water service.

I. Valves, pumps and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

1.04 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One mechanical seal for each pump.

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
   1. Warranty Period: One year from date of substantial completion.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Inline Circulator Pumps:
      a. Bell & Gossett, ITT
      b. Grundfos Pumps, Corp.
   2. Aquastats:
      a. Honeywell

2.02 PUMPS, GENERAL

A. Pumps and circulators: factory assembled, and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 INLINE CIRCULATOR PUMPS

A. General Description: Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, all-bronze, radially split case design, with mechanical seals, permanently lubricated ball bearings and rated for 125 psig working pressure and 225 deg F continuous water temperature.

B. Casings: Cast lead free bronze, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gauge tappings at inlet and outlet connections.

C. Impeller: Statically and dynamically balanced, closed, overhung, single suction, fabricated from cast lead free bronze conforming to ASTM B 584, and keyed to shaft.

D. Pump Shaft and Sleeve: Steel shaft with oil-lubricated copper sleeve.

E. Mechanical Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.

F. Pump Bearings: Oil-lubricated, bronze journal and thrust bearings.

G. Motor Bearings: Oil-lubricated sleeve bearings.

H. Shaft Couplings: Flexible; capable of absorbing torsional vibration and shaft misalignment.

I. Motors: Resiliently mounted to the pump casing.

2.04 AQUASTATS:

A. Remote sensing bulb type, non-modulating, single pole double pole throw with surface mount sensing bulb and mounting bracket, adjustable direct reading scale for set point with adjustable differential.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.02 INSTALLATION

A. General: Comply with the manufacturer's written installation and alignment instructions.

B. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

D. Suspend inline pumps with althread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

3.03 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.
   1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."

B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
   1. Alignment tolerances shall meet manufacturers recommendations.

3.04 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.

C. Install a nonslam check valve and shutoff valve on the discharge side of pumps.

D. Install a gate valve and strainer on the suction side of inline pumps.

E. Install pressure gauges on the suction and discharge of each pump at the integral pressure gauge tappings provided.

F. Install pressure gauge connector plugs in suction and discharge piping around pump. Pressure gauge connector plugs are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

G. Install surface mounted aquastat on bare metal pipe, fastened securely to pipe upstream of circulator pump when indicated on the drawings.

H. Interlock aquastat with hot water recirculation pump motor. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

I. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

J. Coordinate interlock of high flow rate, low suction pressure and high discharge pressure level alarms with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

3.05 FIELD QUALITY CONTROL

A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.06 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
   1. Lubricate oil-lubricated bearings.
   2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
   3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
   4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
   1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
   2. Open the valve in the cooling water supply to the bearings where applicable.
   3. Open the sealing liquid supply valve if the pump is so fitted.
   4. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
   5. Open the recirculating line valve if the pump should not be operated against dead shutoff.
   6. Start motor.
   7. Open the discharge valve slowly.
   8. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
   9. Check the general mechanical operation of the pump and motor.
   10. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.

C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.

END OF SECTION 221123

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SECTION 221300
SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 33 Section "Sanitary Sewage Systems," for sanitary drainage piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 011 Section “Kitchen and Food Service Equipment,” for drains and trim furnished with the food service and kitchen equipment.
5. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads.
7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
8. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
10. Division 22 Section “Water Distribution Piping and Specialties,” for material and methods for trap primers and trap primer inlet piping.

1.02 DEFINITIONS

A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specifications Sections.

B. Product data for the following products:
   1. Drainage piping
   2. Drainage piping specialties
   3. Floor drains
   4. Trench drains
   5. Interceptors

C. Test reports specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:
   1. 2023 Florida Plumbing Code

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:
      a. Zurn Industries, Inc.; Hydromechanics Div.
   2. Non-Metallic Trench Drains:
      a. Zurn Industires, Inc.
   3. Plastic Hydromechanical Grease Interceptors:
      a. Schier Products
   4. Hydromechanical Grease Interceptors (If Schier is not approved by AHJ):
      a. Jay R. Smith Mfg. Co.
      b. Josam Mfg. Co.
      c. Mifab Manufacturing, Inc.
      d. Rockford Sanitary Systems
      e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
      f. Watts Industries, Inc.
      g. Zurn Industries, Inc.; Hydromechanics Div.
   5. Trap Seals
      a. Proset Systems “Trap Guard”
   6. PVC DWV Expansion Joints
      a. Charlotte Pipe and Foundry Company #133
      b. Spears Manufacturing Company #S119

2.02 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. Refer to Part 3, Article "Pipe Applications - Above Ground, Within Building" for identification of systems where the materials listed below are used.

B. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
   1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
   2. Solvent: ASTM D2564.

C. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.03 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

A. Refer to Part 3, Article "Pipe Applications - Below Ground, Within Building" for identification of systems where the materials listed below are used.

B. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
   1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
   2. Solvent: ASTM D2564.

C. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.04 DRAINAGE PIPING SPECIALTIES

A. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

B. Cleanout Plugs: As specified on the drawings.

C. Floor Cleanouts: As specified on the drawings.

D. Wall Cleanouts: As specified on the drawings.

E. Floor Drains: As specified on the drawings.

F. Floor Troughs: As specified on the drawings.

G. Trap Seals: Provide trap seals meeting either description below:
   1. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck’s bill to open and adequately discharge to floor drain through its interior. The duck’s bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete.

2.05 PVC DWV EXPANSION JOINTS

A. Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

2.06 TRENCH DRAINS

A. Trench drain type designations and sizes are indicated on the Drawings.

B. Non-Metallic Trench Drains: Polyester resin and quartz aggregate, precast, interlocking design, with bottom radius and 0.6 percent slope.
   1. Precast Material: Load pressure of 14,500 psi, bending pressure of 2,900 psi, frost-proof, salt-proof, inert under dilute acid and alkali conditions, and less than 1.0 percent water absorption rate.
   2. Grates: Cast iron or steel as indicated, for heavy-duty truck traffic, with openings designed to prevent entry of bicycle or wheelchair tires.

2.07 INTERCEPTORS

A. Interceptor type designations, flow rates, and capacities are indicated on the drawings.

B. Gravity Grease Interceptor: Reinforced precast concrete construction by local manufacturer or a plastic grease interceptor acceptable to the local authorities having jurisdiction.

C. Hydromechanical Grease Interceptor: As scheduled on the drawings.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

A. Pipe Beds:
   1. PVC Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Condensate drain piping and pumped condensate drain piping inside the building: Provide ¾" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.
   1. Install "solid wall" PVC Type DWV pipe and fittings.

B. Condensate drain piping outside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope condensate piping at 1/8" per foot minimum slope to discharge point. Discharge to roof receptors or roof drains with air gap.
   1. Install galvanized schedule 40 steel pipe and malleable iron fittings.

C. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe, except install no plastic pipe in return air plenums.

D. Install 1/2" type L copper tube for trap primer outlet piping.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24" and smaller. Install fabricated fittings for 16 inch and larger.

B. Install PVC pressure pipe and fittings for sump pump discharge.

C. Install 1/2" type K soft copper tube for trap primer outlet piping.

3.05 PIPE AND TUBE JOINT CONSTRUCTION

A. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

B. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

C. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.06 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.

I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.

K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install all drainage piping upstream of grease interceptors at a minimum slope of ¼ inch per foot. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.

P. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.

Q. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.

R. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

3.07 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
   a. Install high density insulation on insulated pipe.
4. Provide vinyl coated hangers and riser clamps for use with PVC pipe and CPVC CTS tube.
5. Provide roll hangers for individual horizontal runs 100 feet or longer.
6. Provide ceiling flanges attached to the floor, all thread rod and split ring pipe clamps for indirect drains and condensate drains supported from the floor 2" and smaller.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size – In.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - In.
Up to 1-1/4	6	3/8
1-1/2 to 2	10	3/8
2-1/2 to 4	10	3/8
5	10	1/2
6	10	1/2
8	10	1/2
10 to 12	10	5/8
14 to15	N/A	3/4

Nom. Pipe Size In Inches.	CTS CPVC Tube Max. Span - Ft.	CPVC Tube Min. Rod Dia. - In.
1/2	3	3/8
3/4	3	3/8
1	3	3/8
1-1/4	4	3/8
1-1/2	4	3/8
2	4	3/8

1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of horizontal of PVC piping every four feet.
4. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
5. Support vertical PVC pipe and tube every six feet, at base of each floor, and provide mid-story guides.
6. Support piping within 12" of each elbow or tee.
7. Support each P-trap.

D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

E. Sway bracing:
1. Provide rigid sway bracing for pipe 4" and larger at changes of direction greater than 45 degrees.

F. Bracing:
1. Provide horizontal bracing for pipe 4" and larger at intervals not to exceed 40'.

3.08 INSTALLATION OF PIPING SPECIALTIES

A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil and waste stack.

D. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

E. Floor Cleanouts: Install in below floor building drain piping as indicated, and:
1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;

4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.09 INSTALLATION OF FLOOR DRAINS, FLOOR SINKS AND FLOOR TROUGHS

A. Install floor drains, floor sinks, shower linear trench drains and floor troughs in locations indicated.

B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.

C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

DEPRESSION IN INCHES	RADIUS OF AREA DRAINED - FEET
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

D. Provide P-traps for drains connected to the sanitary sewer.

E. Install floor drains, floor sinks, shower linear trench drains, and floor troughs in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF TRAP PRIMERS

A. Install trap primer outlet piping with 1/32” per foot slope towards drain trap where possible.

B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.

C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2” thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation” for flexible unicellular insulation.

D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:
1. Install below elevated floor slabs.

2. Install in the sub grade of slab on grade.

E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.

F. Refer to Division 22 Section “Water Distribution Piping and Specialties” for trap primer and trap primer inlet pipe requirements.

3.11 INSTALLATION TRAP SEALS:

A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.

B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.

C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.

D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.12 CONNECTIONS

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 FIELD QUALITY CONTROL

A. Inspections
   1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
      a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
      b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
      c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
      d. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
   1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1” water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION 221300

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SECTION 221400
STORM DRAINAGE PIPING AND SPECIALTIES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes building storm drainage piping systems, including drains and drainage specialties.

B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 33 Section "Storm Systems," for storm drainage piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 22 Section "Identification for Plumbing Piping and Equipment," for labeling and identification of drainage piping.
5. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
6. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
7. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage piping.
8. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.

1.02 DEFINITIONS

A. Storm Building Drain: That part of the lowest piping of a drainage system which receives the discharge from storm drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Storm Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer or private sewer or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys storm water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product data for the following products:

1. Drainage piping
2. Drainage piping specialties
3. Roof drains

C. Test reports specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:
1. 20__ International Plumbing Code
2. 20__ Uniform Plumbing Code

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Drainage Piping Specialties, including cleanouts, roof drains, and downspout nozzles:
   a. Josam Mfg. Co.
   b. Sioux Chief Manufacturing Co. Inc.
   c. Smith (Jay R) Mfg. Co.
   d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
   e. Watts Industries, Inc.
   f. Zurn Industries, Inc.; Hydromechanics Div.
   g. Mifab Manufacturing, Inc.
2. Heavy Duty Hubless Couplings
   a. Anaco Husky HD-2000
   b. Clamp-All 80in. lb.
   c. Ideal Tridon “HD”
   d. Mifab Manufacturing, Inc. #MI-XHUB-series
   e. Mission Rubber Company “Heavyweight”
   f. ProFlo “HD”
3. Downspout Boots 4” and smaller
   a. Josam Mfg. Co.
   b. Smith (Jay R) Mfg. Co.
   c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
   d. Watts Industries, Inc.
   e. Zurn Industries, Inc.; Hydromechanics Div.
   f. Mifab Manufacturing, Inc.Neenah Foundry Company
4. Downspout Boots 5” and larger
   a. Barrycraft
   b. R. J. Hoe
   c. Piedmont Pipe Manufacturing
5. Cast Iron Soil Pipe and Fittings
   a. AB & I Foundry
   b. Charlotte Pipe and Foundry Company
   c. Tyler Pipe / Soil Pipe Division
6. Shielded Transition Couplings

a. FERNCO, “Proflex 3000 Series”
b. Anaco-Husky #SD4200
c. Mission Rubber Company, “Band Seal Specialty Couplings”

7. Underground Shielded Adapter Couplings
   a. FERNCO, “1056 Series with SR73 Shear Ring”
   b. Mifab Manufacturing, Inc. #MI-HUB-ARC-CL-series
   c. Mission Rubber Company, “MR56 Series”
8. PVC DWV Fittings 16” and Larger
   a. Plastic Trends, Inc.
9. Hubless Fitting Restraints
   a. Holdrite
10. Heavy Duty Hubless Couplings for Below Slab
    a. Anaco Husky HD-4000
    b. Clamp-All 125in. lb.

2.02 ABOVE GROUND DRAINAGE PIPE AND FITTINGS

A. Refer to Part 3, Article "Pipe Applications - Above Ground, Within Building" for identification of systems where the materials listed below are used.

B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings, and bearing the trademark of CISPI and NSF.
   1. Heavy duty couplings and compression gaskets: ASTM C564, ASTM C1540 and meeting FM 1680.

C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
   1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints. Fittings 16” and larger shall be fabricated type.
   2. Solvent: ASTM D2564.

D. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.03 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

A. Refer to Part 3, Article "Pipe Applications - Below Ground, Within Building" for identification of systems where the materials listed below are used.

B. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings, and bearing the trademark of CISPI and NSF. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.
   1. Neoprene Compression Gaskets: ASTM C564.

C. [Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings and bearing the trademark of CISPI and NSF.]
   1. [Heavy-Duty couplings and compression gaskets: ASTM C564, ASTM C1540 and FM 1680.]

D. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.
   1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
   2. Solvent: ASTM D2564.

E. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.04 DRAINAGE PIPING SPECIALTIES

A. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

B. Cleanout Plugs: As specified on the drawings.

C. Floor Cleanouts: As specified on the drawings.

D. Wall Cleanouts: As specified on the drawings.

E. Roof Drains: As specified on the drawings.

2.05 HUBLESS FITTING RESTRAINTS

A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

A. Pipe Beds:
   1. PVC and ABS Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
   2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Install hubless, cast-iron soil pipe and fittings 15” and smaller for storm pipe.

B. Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller storm pipe.

B. [Install hubless, cast-iron soil pipe and fittings 15” and smaller for storm pipe.]

C. Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.

3.05 PIPE AND TUBE JOINT CONSTRUCTION

A. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
   1. Install heavy duty hubless couplings on storm drainage piping, including connections to roof drains.
   2. Install Hubless fitting restraints on joints 5” and larger at:
      a. Changes of direction from vertical to horizontal
      b. 4” branch connections, including tees, wyes and wye combination fittings to storm drainage piping 5” and larger
      c. Horizontal changes of direction 22-1/2 degrees and greater

B. Install heavy duty hubless couplings on hubless storm piping ping below floor.

C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

D. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.

E. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

F. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.06 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.

H. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

J. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.

L. Make changes in direction for drainage piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

M. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

N. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.

3.07 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. [Provide 304 stainless steel rods, nuts, washers and pipe clamps for sway bracing, for piping under slab as detailed on the drawings. Connect rods with rebar tie wires to reinforcing bars in top layer of slab.]
   a. [Pipe clamps for sway bracing: B-Line Fig 4B or approved equal.]
4. [Provide 304 stainless steel dual rods, nuts, washers, pre-engineered support struts and split two piece pipe clamps for supporting floor cleanouts under slab as detailed on the drawings. Connect rods with rebar tie wires to reinforcing bars in top layer of slab.]
5. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
   a. Install high density insulation on insulated pipe.
6. Provide vinyl coated hangers and riser clamps for use with PVC pipe.
7. Provide roll hangers for individual horizontal runs 100 feet or longer.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size	Steel Pipe Max. Span	Copper Tube Max. Span.	Min. Rod Dia. - Inches
In Inches	In Feet	In Feet	
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 3	12	10	3/8
4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support all sizes of hubless horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide sway brace on horizontal piping at not more than 40' intervals to prevent horizontal movement. Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of vertical steel piping every other floor, not to exceed twenty-five feet.
4. Support all sizes of horizontal of PVC piping every four feet.

5. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
6. Support vertical PVC pipe and tube every six feet, at base of each floor, and provide mid-story guides.
7. Support piping within 12” of each elbow or tee.
8. [Support all sizes of underslab hubless horizontal cast iron piping every three feet and every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18”. Provide support at each horizontal branch. For piping 2’-0“ or more deep from bottom of slab, provide Styrofoam block minimum 4” from bottom and sides of pipe up to bottom of slab to prevent heaving of pipe. Cut interior of Styrofoam to fit hangers and fittings. Wrap Styrofoam all around with 7 mil thick plastic sheathing by Visqueen.]

D. Sway bracing:
1. Provide rigid sway bracing for pipe 4” and larger at changes of direction greater than 45 degrees.

E. Bracing:
1. Provide horizontal bracing for pipe 4” and larger at intervals not to exceed 40’.

3.08 INSTALLATION OF PIPING SPECIALTIES

A. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil, waste, or storm water stack.

B. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

C. Floor Cleanouts: Install in below floor building drain piping as indicated and:.
1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

D. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.09 INSTALLATION OF ROOF DRAINS

A. Install roof drains at low points of roof areas with the roof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and roof membrane.

B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

C. Position roof drains so that they are accessible and easy to maintain.

3.10 FIELD QUALITY CONTROL

A. Inspections
   1. Do not enclose, cover, or put into operation the storm drainage piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
      a. Rough-in Inspection: Arrange for inspection of the storm drainage piping system before concealed or closed-in after system is roughed-in.
      b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
      c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
      d. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test storm drainage system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
   1. Test for leaks and defects all new storm drainage piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
   2. Leave uncovered and unconcealed all new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
   3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of storm drainage piping systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
   4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
   5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.11 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers and domes. Remove dirt and debris.

3.12 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Exposed PVC Piping: Protect storm drainage piping exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION 221400

SECTION 221489
SUMP PUMPS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:
   1. Sump pumps

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for sump basins and covers.
   2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
   3. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
   4. Division 22 Section “Storm Drainage Piping and Specialties” for sump pump discharge pipe material and installation requirements.
   5. Division 23 Section “Direct-Digital Control for HVAC” for interlock of alarms with building automation system and alarm wiring.
   6. Division 26 Section “Common Work Results for Electrical” required electrical devices.
   7. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
   1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
   2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
   3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
   4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
   5. Shop drawings showing basins with depth, inlet, outlet and vent locations, pit covers, float switches, non-clog check valves and shutoff valves.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. SSPMA Compliance: Test and rate sump pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Manufacture Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
   1. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
   2. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”

H. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.04 [SPARE PARTS]

A. [Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.]
   1. [Mechanical Seals: One mechanical seal for each pump.]

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
   1. Warranty Period: One year from date of substantial completion.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
1. Elevator Pit Sump Pumps:
a. ABS Pump, Inc.,
b. FLYGT
c. Weil Pump Company
2. Sump Pumps:
a. ABS Pump, Inc.
b. FLYGT
c. Weil Pump Company
3. Submersible Sump Pump High Level Alarms:
a. Weil Pump Company
b. Zoeller Pump Company
c. SJE Rhombus
4. Oil Sensing Sump Pump High Level Alarms
a. Weil Pump Company
b. SeeWater, Inc.
5. Full Port Bronze Ball Valves – 2" and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70

6. Full Port Cast Iron Ball Valves – 2-1/2" and larger:
a. Apollo (Conbraco) "6P"
b. Watts "G4000M1"
7. Non-Clog "Flapper Type" Check Valves:
a. Liberty Pumps "Series CVXXXC"
b. Little Giant Pump Company "Series CV-SE"
c. Zoeller Pump Company "Series 30"
8. Cast Iron "Sinking Ball Type" Non-Clog Check Valves - 2" and smaller:
a. Flomatic "208"
b. FLYGT "2002"
c. GW Industries, Inc. "240T"
9. Cast Iron "Sinking Ball Type" Non-Clog Check Valves – 2-1/2" and larger:
a. Flomatic "508"
b. FLYGT "5087"
c. GW Industries, Inc. "240D"
10. Sump Basins
a. AK Industries
b. Fiberbasin, Inc.
c. Topp
11. Basin Covers:
a. Bilco
b. U.S.F. Fabrication

12. Control Panels
    a. Cougar Sales
    b. Sulzer
    c. FLYGT
    d. Weil Pump Company

2.02 PUMPS, GENERAL

A. Pumps: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 ELEVATOR PIT SUMP PUMPS – ¾ HP AND SMALLER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.

B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.

G. Controls: NEMA 1, tethered float switch for “on-off” control with “piggy back” power cord connection for sump pump power cord.

2.04 ELEVATOR PIT SUMP PUMPS – 1 HP AND LARGER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal,

permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.

B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. [Seals: Tandem mechanical seals mounted in cast iron body seal chamber with upper seal of carbon rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket and lower seal of silicon carbide rotating ring, stainless-steel spring, silicon carbide seat, and Buna-N bellows and gasket.]

G. Motor: Hermetically sealed, with built-in overload protection, air filled, 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.

H. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset, internal test-off-automatic pump run switch, 120V control circuit transformer fused on primary and secondary, non-resettable pump run time hour meter, and terminal board for connection of pump, wiring and level sensors.

1. Provide with
   a. Power "on" indicator light.
   b. Pump "on" indicator light.
   c. Overload alarm relay and indicator light.
   d. High level alarm relay, horn and light with switch.
   e. [Oil sensor and oil sensor alarm indicator light, horn and with switch.]
   f. Auxiliary alarm contacts for each alarm condition.
2. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
3. Disconnect: Disconnect is provided under Division 26 Section "Enclosed Switches and Circuit Breakers".
4. Sequence of operation:
   a. The elevator sump pump shall be in automatic mode.
   b. When the water level rises from the level of pump "off" to the level of pump "on", the panel shall start thead pump.
   c. When the water level drops to the level of pump "off", the panel shall stop the pump.
5. Safeties:
   a. High Level Alarm

1) When the water level rises to the level of "high level alarm" an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

b. Thermal Overload Alarm

1) When the thermal overload actuates and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

c. [Oil Sensor Alarm

1) When the oil sensor detects oil and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.]

I. Controls: NEMA 1 steel vandal resistant double door dead front enclosure, thru door disconnect, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset, internal test-off-automatic pump run switch, 120V control circuit transformer fused on primary and secondary, non-resettable pump run time hour meter, and terminal board for connection of pumps and level sensors.

1. Provide with
   a. Power "on" indicator light.
   b. Pump "on" indicator light.
   c. Overload alarm relay and indicator light.
   d. High level alarm relay, horn and light with switch.
   e. [Oil sensor and oil sensor alarm indicator light.]
   f. [Moisture sensor alarm light, horn and switch.
   g. High temperature shutdown alarm light.
   h. Auxiliary alarm contacts for each alarm condition.
2. Circuit breaker shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
3. Sequence of operation:
   a. The elevator sump pump shall be in automatic mode.
   b. When the water level rises from the level of pump "off" to the level of pump "on", the panel shall start thead pump.
   c. When the water level drops to the level of pump "off", the panel shall stop the pump.
4. Safeties:
   a. High Level Alarm
      1) When the water level rises to the level of "high level alarm" an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   b. [Moisture Sensor Alarm
      1) When the moisture sensor in each pump detects moisture, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.]
   c. High Temperature Shutdown Alarm
      1) When the temperature sensor in a pump detects moisture, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   d. Thermal Overload Alarm

1) When the thermal overload actuates and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

e. [Oil Sensor Alarm

1) When the oil sensor detects oil and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.]

2.05 SIMPLEX SUMP PUMPS – ¾ HP AND SMALLER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.

B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2” diameter sphere. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.

G. Basin: Fiberglass reinforced plastic, PVC plastic is not acceptable, with a minimum wall thickness of 3/16”, 2” wide retainer ring at the basin bottom and every four feet and factory pipe penetration connection kits. Refer to the drawings for basin dimensions.

H. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

I. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. [Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.]

J. Controls: NEMA 1, tethered float switch for “on-off” control with “piggy back” power cord connection for sump pump power cord.

2.06 SUMP PUMPS

A. General Description: Pumps shall be [simplex] [duplex] centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.

B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. [Vertical discharge with screwed female connection.] [Horizontal discharge companion flange] [and rail retrieval system.]

C. Rail Retrieval System: Provide with cast iron floor elbow, gasket, anchor bolts, yoke, pipe guides, stainless steel rope, and upper guide bracket.

D. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

F. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

G. [Seals: Tandem mechanical seals mounted in cast iron body seal chamber with upper seal of carbon rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket and lower seal of silicon carbide rotating ring, stainless-steel spring, silicon carbide seat, and Buna-N bellows and gasket.]

H. Motor: Hermetically sealed, with built-in overload protection, air filled, [explosion proof], 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.

I. Basin: Fiberglass reinforced plastic, PVC plastic is not acceptable, with a minimum wall thickness of 3/16", 2" wide retainer ring at the basin bottom and every four feet and factory pipe penetration connection kits. Refer to the drawings for basin dimensions.

J. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

K. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. [Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.]

L. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps, wiring and level sensors and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition.

1. Provide with indicator lights in factory standard colors for:
    a. Power "on" light.
    b. Pump "on" light for each pump.
    c. Second pump running light.
    d. Thermal overload alarm light for each pump.
    e. High level alarm light and horn with test switch.
    f. Auxiliary alarm contacts for each alarm condition.

2. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings
3. ontrol panel shall be configured for terminating one incoming power feeder
4. Disconnect: Disconnect is provided under Division 26 Section "Enclosed Switches and Circuit Breakers".of operation:
    a. The sewage ejector shall be in automatic mode.
    b. When the water level rises from the level of pumps “off” to the level of first pump “on”, the panel shall start the lead pump.
    c. If water level rises to the water level of second pump “on”, the panel shall start the lag pump.
    d. When the water level drops to the level of pump “off”, the panel shall stop the pumps. The lag pump shall start for the next control sequence.
5. Safeties:
    a. High Level Alarm
        1) When the water level rises to the level of “high level alarm” an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
    b. Second Pump Running Alarm
        1) When the water level rises to the level of second pump “on”, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
    c. Thermal Overload Alarm
        1) When the thermal overload actuates and shutss down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

M. Controls: NEMA 4 enclosure with vandal resistant double door dead front with lockable through door [fusible] disconnect, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, internal test-off-automatic selector switches, overload relays and indicator lights, resets, 120V control circuit transformers fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps, wring and level sensors and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition.
1. Provide with indicator lights in factory standard colors for:
    a. Power “on light.
    b. Pump “on” light for each pump.
    c. Second pump running light.
    d. Thermal overload alarm light for each pump,
    e. High level alarm horn and light with test switch.
    f. Moisture sensor alarm light for each pump.
    g. High temperature shutdown alarm light for each pump.
    h. Auxiliary alarm contacts for each alarm condition.
2. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings
3. Control panel shall be configured for terminating one incoming power feeder.
4. Sequence of operation:
    a. The sewage ejector shall be in automatic mode.

b. When the water level rises from the level of pumps “off” to the level of first pump “on”, the panel shall start the lead pump.
c. If water level rises to the water level of second pump “on”, the panel shall start the lag pump.
d. When the water level drops to the level of pump “off”, the panel shall stop the pumps. The lag pump shall start for the next control sequence.

5. Safeties:
   a. High Level Alarm
      1) When the water level rises to the level of “high level alarm” an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   b. Second Pump Running Alarm
      1) When the water level rises to the level of second pump “on”, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   c. Moisture Sensor Alarm
      1) When the moisture sensor in each pump detects moisture, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   d. High Temperature Shutdown Alarm
      1) When the temperature actuates and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   e. Thermal Overload Alarm
      1) When the thermal overload actuates and shutss down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

N. Controls: NEMA 4 enclosure with vandal resistant double door dead front with lockable through door [fusible] disconnect, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, internal test-off-automatic selector switches, overload relays and indicator lights, resets, 120V control circuit transformers fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps, wiring and level sensors and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition.
   1. Provide with indicator lights in factory standard colors for:
      a. Power “on light
      b. Pump “on” light for each pump.
      c. Second pump running light
      d. Thermal overload alarm light for each pump.
      e. High level alarm horn and light with test switch.
      f. Auxiliary alarm contacts for each alarm condition.
   2. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
   3. Control panel shall be configured for terminating one incoming power feeder.

O. Controls: NEMA 4 enclosure with vandal resistant double door dead front with lockable through door [fusible] disconnect, lockable combination circuit breaker magnetic motor starter and 3 leg

overload protection with reset for each motor, internal test-off-automatic pump run switches, two 120V control circuit transformers fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps, wiring and level sensors, lightening arrestor and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition.

1. Provide with indicator lights in factory standard colors for:
   a. Power “on” light.
   b. Pump “on” light for each pump.
   c. Second pump running light
   d. Thermal overload light for each pump.
   e. High level alarm light and horn with test switch.
   f. Moisture sensor alarm light for each pump.
   g. High temperature shutdown light for each pump, and auxiliary alarm contacts for each alarm condition.
2. [Provide with floor mounting stand for free standing control panel.]
3. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
4. Control panel shall be configured for terminating one incoming power feeder.
5. Sequence of operation:
   a. The sewage ejector shall be in automatic mode.
   b. When the water level rises from the level of pumps “off” to the level of first pump “on”, the panel shall start the lead pump.
   c. If water level rises to the water level of second pump “on” , the panel shall start the lag pump.
   d. PWhen the water level drops to the level of pump “off”, the panel shall stop the pumps. The lag pump shall start for the next control sequence.
6. Safeties:
   a. High Level Alarm
      1) When the water level rises to the level of “high level alarm” an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   b. Second Pump Running Alarm
      1) When the water level rises to the level of second pump “on”, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   c. Moisture Sensor Alarm
      1) When the moisture sensor in each pump detects moisture, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   d. High Temperature Shutdown Alarm
      1) When the temperature sensor actuates and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
   e. Thermal Overload Alarm
      1) When the thermal overload actuates and shuts down the pump, an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

P. VFD Controls: NEMA 4 enclosure with dead front door with lockable through door [fusible] disconnect, programmable logic controller (PLC), lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, terminal board for connection of pumps, wiring and level sensors.

1. Provide touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump. PLC shall alternate lead-lag pump selection and to provide for two pumps to operate simultaneously under high level condition with third pump as standby. PLC shall alternate standby pump as "first "on" pump" after end of each pumping cycle. Provide with virtual indicator lights in factory standard colors for:
   a. Power "on" light.
   b. Pump "on" light for each pump.
   c. Second pump running light.
   d. Thermal overload alarm light for each pump.
   e. High level alarm light and horn with reset switch.
   f. Second pump running alarm light.
   g. PLC failure alarm light.
   h. Level transmitter failure light.
   i. Moisture sensor alarm light for each pump.
   j. High temperature shutdown alarm light for each pump.
   k. Auxiliary alarm contacts for each alarm condition.
2. Provide with level transmitter with base and (3) redundant float switches.
3. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.
4. Control panel shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.
5. [Provide with second vandal resistant double door dead front.]
6. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
7. Variable Speed Drive: The variable speed drives (VFD) shall be adjustable frequency which employ a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To ensure safety of the equipment, the VFD shall include these protective features and options:
   a. NEMA 1 enclosure.
   b. Static instantaneous over-current and over-voltage trip.
   c. Static over-speed (over-frequency) protection.
   d. Line or fuse loss and under-voltage protection.
   e. Power unit over-temperature protection.
   f. Motor inverse time overload protection.
   g. Input fused disconnect or circuit breaker.
   h. Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
   i. Speed meter.

j. Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
k. Power on light.
l. Manual speed potentiometer or control capability through the keypad.
m. Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
n. Test switch
o. VFD fault light and reset.
p. Output to the PLC and integral LED display
q. The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters and for first fault indication, and digital input programming capability on the main logic board.
r. The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
s. All control circuit voltages shall be physically and electrically isolated from power circuit voltages.

8. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
9. Sequence of operation:
   a. Minimum run speed is 48Hz or 1400 rpm.
   b. The sewage ejector shall be in automatic mode.
   c. When the water level rises from the level of pumps "off" to the level of first pump "on", the PLC shall start the lead pump. The PLC shall modulate the pump speed to maintain the water level in the pit at the level of first pump "on".
   d. If water level rises to the water level of second pump "on", the PLC shall start the lag pump with a minimum run speed of 1400 rpm and the first pump will run with a minimum run speed of 1400 rpm. The PLC shall modulate the pumps speed to maintain the water at the level of second pump "on". When water level drops to the level of first pump "on", the PLC shall stop the lead pump.
   e. When the PLC runs the pump at 48Hz or 1400 rpm and the water level drops to the level of pump "off", the PLC shall stop the pump. The lag pump shall start for the next control sequence. If a pump runs continuously for 24 hours, the PLC shall stop the lead pump and start the lag pump.
10. Safeties:
    a. High Level Alarm
       1) When the water level rises to the level of "high level alarm" an audible alarm shall sound and an alarm signal shall be sent to the BMS or local building alarm system.
    b. Second Pump Running Alarm
       1) When the water level rises to the level of second pump "on", an alarm signal shall be sent to the BMS or local building alarm system.
    c. Moisture Sensor Alarm
       1) When the moisture sensor in a pump detects moisture, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.
    d. High Temperature Shutdown Alarm

1) When the temperature sensor actuates and shuts down the pump, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

e. Level Transmitter Failure and Alarm

1) If the level transmitter fails to send control signal to the PLC, the PLC shall shift control of the pumps via the failsafe relay to use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) When the level transmitter fails to send control signal to the PLC, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

f. PLC Failure and Alarm

1) If the PLC has loss of power or logic failure, the failsafe relay shall use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) The failsafe relay shall send a "PLC Failure Alarm" alarm signal to the BMS or local building alarm system.

g. [Data Interface: Provide BACnet card following alarm and data conditions:

1) High level alarm.
2) Second pump running alarm.
3) Moisture sensor alarm for each pump.
4) High temperature shutdown alarm for each pump.
5) Level transmitter failure alarm.
6) PLC failure alarm.

Q. Level Controls: Pole mounted tethered float switches with chord grips, pole mounting plate and cover. Float switches shall be 120V 3 amp single pole normally open that closes on the rise for pump "off", first pump "on" second pump "on" and high level alarm.

R. Junction Box: NEMA 6P enclose of fiberglass reinforced polyester with fully gasketed cover, terminal strip and inlets and outlets for four control and two power connections.

2.07]SUMP PUMP HIGH LEVEL ALARMS

A. Alarm: Remote type 120V single phase with NEMA 4X enclosure, terminal block, 5 amp isolated alarm contact, alarm horn, alarm light, test-automatic-silence switch and mechanical float switch.

1. Safeties:

a. High Level Alarm

1) When the water level rises to the level of "high level alarm" an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

2.08 OIL SENSING SUMP PUMP ALARMS

A. Alarm Panel: Remote type 120V NEMA 3R panel, oil and water sensor, power cord, receptacle for pump power cord, 85 bd alarm horn, oil present alarm light, water present alarm light, high elev alarm light, silence switch, test switch and alarm contacts for each alarm condition.
   1. Safeties:
      a. High Level Alarm
         1) When the water level rises to the level of “high level alarm” an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
      b. Oil Present Alarm
         1) When the sensor detects oil an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.
      c. Water Present Alarm
         1) When the sensor detects water an audible alarm shall sound, an alarm light activate and alarm signal shall be sent to the BMS or local building alarm system.

2.09 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast bronze, full port, blowout-proof stem and chrome-plated brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder or threaded ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200-psi CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

2.10 CHECK VALVES

A. Non Clog “Flapper Type” Check Valves, 2 Inch and Smaller: Flapper type with PVC body compression end fittings with Buna-N “O” ring and Buna-N flapper with PVC shields.

B. Non Clog “Sinking Ball Type” Check Valves: Sinking ball type with cast iron body, steel ball with hollow core and Buna-N coating. Valve body shall be configured for unobstructed flow. Valves 2” and smaller with screwed ends and valves 2-1/2” and larger with flanged ends.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

E. Basins: Install sump pump basins in indicated locations and connect to drainage lines. Brace interior of basin in accordance with manufacturer's instructions to prevent distortion or collapse during concrete placement. Refer to Division 3 for concrete work. Set cover over basin and fasten to top flange of basin. Install so cover is flush with finished floor.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install discharge pipe sizes equal to or greater than the diameter of the pump nozzles. Sump pump discharge pipe material is specified in Division 22 Section “Storm Drainage Piping and Specialties”.

C. Install a non-clog check valve in an accessible location or where indicated on the drawings. Install a full port ball valve on the discharge side of sump pumps downstream of the check valve.

D. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

E. Install inlets or outlets to fiberglass sump basins in the field at the required elevation. Cut inlet or outlet per the basin manufacturer’s instructions, as installation requires with factory penetration kits at each penetration. See drawings for inlet and outlet elevations.

F. Install sump basin inlets or outlets in the field at the required elevation. Seal penetrations with mechanical link seals. Mechanical link seals are specified in Division 22 Section "Basic Piping Material and Methods." See drawings for inlet and outlet elevations.

G. Coordinate interlock of elevator pit high level alarm [, water present alarm and oil present and shutdown alarm] with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

H. Coordinate interlock of elevator sump pump high level, [moisture sensor, high temperature shutdown,] [oil present and shutdown alarm] and thermal overload shutdown alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

I. Coordinate interlock of elevator sump pump high level, [two moisture sensors, two high temperature shutdowns,] [oil present and shutdown alarm] and thermal overload shutdown alarm

with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

J. Coordinate interlock of sump pump high level, two moisture sensor, two high temperature shutdown, two overload alarms, second pump running alarm, PLC failure alarm and level transmitter failure alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

K. [Coordinate interlock of sump pump with building automation system via BACnet protocol for high level alarm, second pump running alarm, two moisture sensor alarms, two high temperature shutdown alarms, level sensor failure alarm and PLC failure alarm. Wiring and interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".]

3.04 FIELD QUALITY CONTROL

A. Pressure Testing: Perform a pressure test on the discharge assembly. The test pressure shall be twice that of the shut off head of the pump.

B. Valve Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.05 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
   1. Lubricate oil-lubricated bearings.
   2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
   3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
   4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
   1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
   2. Start motor.
   3. Open the discharge valve slowly.
   4. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
   5. Check the general mechanical operation of the pump and motor.

C. If the pump is to be started against a closed check valve with the discharge shut-off valve open, the steps are the same except that the discharge shut-off valve is opened some time before the motor is started.

END OF SECTION 221489

SECTION 223400
FUEL FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes commercial gas fired water heaters.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
2. Division 22 Section “Common Work Results for Plumbing” for concrete equipment pads.
3. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
4. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
5. Division 22 Section “Natural Gas Piping” for natural gas equipment connections.
6. Division 23 Section "Breechings, Chimneys, and Stacks" for gas-fired water heater vents.
7. Division 26 Section “Common Work Results for Electrical” required electrical devices.
8. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.03 QUALITY ASSURANCE

A. UL Standards: Provide water heaters complying with the following:
1. UL 778, "Motor Operated Water Pumps."

B. NSF Standards: Provide water heaters complying with NSF No. 5, "Standard for Hot Water Generating Equipment for Food Service Establishments using Spray Type Dishwashing Machines," and bearing NSF label.

C. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

D. Listing and Labeling: Provide water heaters that are listed and labeled.
   1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. AGA Standards: Provide water heaters that bear the label of the American Gas Association.

F. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."

G. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of water heaters is on the proposer.

1.04 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, coils, heat exchangers, and burners. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
   1. Commercial, Gas Fired, Storage Water Heaters:
      a. Storage Tank: Three years.
      b. Controls and Other Components: One year.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Commercial Sealed Combustion Gas-Fired Condensing Tank Type Water Heaters:
      a. Bradford-White Corp.
   2. Approved Equals: Equals shall only be provided when primary manufacturer has lead times outside of the acceptable delivery date and as approved by Sprouts.
      a. Rheem Mfg.
   3. Thermal Expansion Tanks
      a. Armstrong Pumps, Inc.
      b. Amtrol, Inc.
      c. Bell & Gosset, ITT
      d. Elbi
      e. TACO, Inc.

f. Watts
g. Wessels Tank Co.

4. Pressure Relief Valves
   a. Apollo #16LF-202
   b. Cash ACME #FW
   c. Watts #LF53
   d. Wilkins #P1520XL
5. Vacuum Relief Valves
   a. Apollo #37
   b. Cash ACME #VR-801
   c. Watts #N36
   d. Wilkins #VR-10
6. Water Heater Drain Pans
   a. Holdrite
   b. Killarney Metals
   c. Oatey

2.02 SEALED COMBUSTION GAS-FIRED CONDENSING TANK TYPE WATER HEATERS

A. Description: sealed combustion gas-fired tank type with submerged combustion chamber, glass lined heat exchanger coil, 150-psig-rated storage tank, fan assisted combustion with exhaust fan, hot surface ignition system with flame monitoring system, magnesium anode, integral thermostats and controls, and temperature & pressure relief valve. Low NOx burner meeting SCAQMD Rule 1146.2.
   1. Fuel: Natural gas.

B. Insulation: Fiberglass, surrounding tank.

C. Jacket: Steel, with baked-on enamel finish.

D. Tank: Glass-lined steel, with anode rods and drain valve.

E. Controls:
   1. Adjustable immersion thermostat.
   2. Intermittent electronic ignition.
   3. User Interface Module (ULM): Designed specifically for display of fault and alarm conditions for water heater control for staging gas burner, combustion air and exhaust fans, setting of operating temperature, operating temperature status, high-temperature-limit cutoff, display of trouble and shitdown conditions.
   4. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank.

F. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

G. Condensate Neutralization Kits: PVC body with socket weld inlets and outlets, minimum ¾". Capacity to match heater input.

2.03 THERMAL EXPANSION TANKS

A. Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel listed for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base.

2.04 VACUUM RELIEF VALVES

A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

2.05 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: ½” lead free brass body meeting ANSI Z21.22 with screwed ends, stainless steel spring and factory set to relieve at 100 psig

2.06 WATER HEATER DRAIN PANS

A. Galvanized steel or aluminum with outside diameter minimum 2” greater than water heater diameter, with 3/4” screwed drain outlet.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install in accordance with manufacturer’s installation instructions.

B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

C. Install thermometers on water heater outlet piping. Thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

D. NFPA Compliance: Install gas-fired water heaters in compliance with NFPA 54, "National Fuel Gas Code."

E. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

F. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.

G. Water Heater Drain Pan: Install under water heater on wall or ceiling supports or resting on elevated floor slabs. Install drain pan drain line to discharge to an approved receptor with air gap.

H. Install pressure relief valve on cold water supply to water heater downstream of shutoff and check valves. The pressure relief shall be factory set to 100 psig. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

I. Install condensate neutralization kit furnished with water heater condensate drain downstream of trap at condensate connection. Fill kit with water heater manufacturer recommended neutralization media.

3.02 CONCRETE EQUIPMENT BASES

A. Construct concrete equipment bases in accordance with Section “Basic Mechanical Materials and Methods” for setting of equipment.

3.03 EXPANSION TANK INSTALLATION

A. Install in-line expansion tanks in the vertical or horizontal position (where allowed by manufacturer). Where tanks are installed in horizontal position, provide supports per manufacturer requirements.

B. Install stand mounted expansion tanks on concrete equipment bases.

C. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
   2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
      a. Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
      b. Install vacuum relief valve in cold water inlet piping.
   3. Connect gas supply piping to burner with drip leg, tee, gas cock, and union; minimum size same as inlet connection. Arrange piping to allow unit servicing. Gas piping is specified in Division 22 Section “Natural Gas Piping”.
      a. Install vent piping from gas train pressure regulators and valves to outside the building. Terminate vent piping with brass screened vent cap fitting. Do not combine vents except with approval of local authority.
      b. Install gas pressure regulators where indicated.
   4. Install drain as indirect waste to spill into open drain or over floor drain.
      a. Install drain valve at low point in water piping, for water heaters not having tank drain.
   5. Install heat traps at inlet and outlet of each water heater storage tank. Heat trap shall be made of elbows and piping. Heat trap shall turn down to 12” below the outlet or inlet, run

12" horizontal and turn up to the cold water to the heater or hot water from the heater. Where multiple tanks are connected with a manifold, a single heat trap may be provided at the connection of the cold water supply to the cold water manifold together.

B. Electrical Connections:
   1. Power wiring is specified in Division 26 Section "Common Work Results for Electrical"
   2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
   3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.
   4. Vents are specified in Division 23 Section "Breechings, Chimneys, and Stacks."

C. Vent Connections for Sealed Combustion Tank Type Gas Fire Water Heaters:
   1. Vents are specified in Division 23 Section "Breechings, Chimneys, and Stacks."
   2. Furnish intake and exhaust vent terminal furnished by heater manufacturer for installation by mechanical.
   3. Provide ¾" PVC indirect drain from manufacturer exhaust fitting indirect drain connection furnished with water heater. Provide ¾" PVC P-trap with minimum 1" trap seal and route indirect drain to nearest floor drain, discharge to floor drain with air gap.

Install condensate neutralization kit furnished with water heater on floor adjacent to water

D. Install condensate neutralization kit furnished with water heater on floor adjacent to water heater in an accessible location.

3.05 FIELD QUALITY CONTROL

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.
   1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

3.06 STARTUP

A. Perform the following before start-up final checks:
   1. Fill water heaters with water.
   2. Piping systems test complete.
   3. Check for piping connections leaks.
   4. Check for adequate combustion air.
   5. Check for clear vent.
   6. Test operation of safety controls and devices.

B. Perform the following start-up procedures:
   1. Energize circuits.
   2. Adjust operating controls.
   3. Adjust hot water outlet temperature setting.

3.07 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
   1. Overview of the system and/or equipment as it relates to the facility as a whole.
   2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
   3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 223400

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SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 7 Section "Joint Sealers," for materials and methods for sealing between plumbing fixtures and interior walls.
   2. Division 010 Section "Service Wall Systems" for wall modules with built-in plumbing fixtures.
   3. Division 22 Section "General Duty Valves for Plumbing Piping" for valves used as supply stops.

C. Products furnished but not installed under this Section include:
   1. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment provided by Owner.
   2. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment specified in other Sections.

D. Products installed but not furnished under this Section include:
   1. Owner furnished fixtures, as indicated.
   2. Accessories, appliances, appurtenances, and equipment specified in other Sections, requiring plumbing services or fixture-related devices, as indicated.

1.02 DEFINITIONS

A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.

B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.

C. Appliance: Device or machine designed and intended to perform a specific function.

D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.

E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.

F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly

into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.

H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.

I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
   1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
   2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
   3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
   4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.

J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
   1. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
   2. Wiring diagrams for field-installed wiring of electrically operated units.
   3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."

B. Submit third party certification that faucets and trim for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following faucets and trim need not comply:
   1. Electronic faucets
   2. Service sink faucets
   3. Flush valves
   4. Shower valves and heads

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of ICC Standard A117.1, "Accessible and Usable Buildings and Facilities," and "2010 ADA Standards for Accessible Design" with respect to plumbing fixtures for individuals with disabilities.

B. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of faucets and trim containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.

C. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

1.05 SPARE PARTS

A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.

B. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.

C. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.

D. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.

E. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.

F. Water Closet Tank Repair Kits: Furnish quantity of identical flush valve units not less than 5 percent of amount of each type installed.

G. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.

H. Filter Cartridges: Furnish quantity of identical filter cartridges not less than 50 percent of amount of each type and size installed.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:
   1. Water Closets:
      a. TOTO KIKI USA, Inc.

b. Zurn Plumbing Products Group

2. Lavatories:
   a. TOTO KIKI USA, Inc.
3. Sinks:
4. Acorn Engineering Co. Plastic Mop Basins:
   a. Zurn Plumbing Products Group
5. Water Coolers:
   a. Oasis
6. Toilet Seats:
   a. Mainline
7. Flushometers – Piston Type:
   a. Toto Kikki, USA
8. Sensor-Operated Faucets and Devices:
   a. Toto Kikki, USA
9. Stop Valves & Supplies:
   a. Brass Craft Subsidiary; Masco Co.
   b. Engineered Brass Company
   c. Mainline
   d. McGuire Manufacturing Co., Inc.PROFLO
   e. Watts Brass and Tubular
   f. Zurn Industries
10. P-traps, Drains & Miscellaneous Fittings:
   a. Brass Craft Subsidiary; Masco Co.
   b. Dearborn Brass
   c. Engineered Brass Company
   d. Franke
   e. Mainline
   f. McGuire Manufacturing Co., Inc.PROFLO
   g. Watts Brass and Tubular
   h. Zurn Industries
11. Supports:
   a. Josam Co.
   b. Mifab Manufacturing, Inc.
   c. Smith (Jay R.) Mfg. Co.
   d. Wade Div.; Tyler Pipe.
   e. Watts Drainage Products
   f. Zurn Industries, Inc.; Hydromechanics Div.
12. Insulation Kits
   a. Brocar
   b. Mainline
   c. McGuire
   d. Plumberex
   e. PROFLO
   f. Trap-Wrap
   g. Truebro, Inc.

2.02 PLUMBING FIXTURES, GENERAL

A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below:

2.03 FAUCETS

A. Faucets General: As described on the drawings.
   1. Electronic faucets shall be of the same manufacturer as the water closet and urinal flush valves.

2.04 STOP VALVES AND SUPPLIES

A. Supplies General: As described on the drawings.
   1. Exposed piping and parts shall be polished chrome plated.

2.05 P-TRAPS, DRAINS, AND MISCELLANEOUS FITTINGS:

A. Fittings General: As described on the drawings, except as listed below.
   1. Exposed piping and fittings shall be polished chrome plated.
   2. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
   3. Fitting and faucet bodies for domestic water distribution shall be of lead free brass or lead free cast bronze.

B. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.

C. Scullery sink Continuous Wastes: Polished chrome-plated, tubular brass, 2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.

D. Bathtub Waste and Overflow Fittings: Concealed 1-1/2-inch, 17-gauge, polished chrome-plated, tubular brass; lever-operated pop-up bath waste and overflow, spud with universal-type outlet connection suitable for 1-1/2-inch tubing, or 1-1/2-inch solder-joint outlet connection on waste tee.

E. Escutcheons: Wall flange with set screw.

F. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.

G. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

2.06 FLUSHOMETERS

A. Provide flushometers compatible with fixtures, with features and of consumption indicated as described on the drawings.
   1. Exposed metal parts shall be polished chrome plated.
   2. Flush valves installed within wall construction may be without chrome plate finish.

2.07 TOILET SEATS

A. General: As described on the drawings.

2.08 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.

B. Support categories are:
   1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
   2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
   3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
   4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.

C. Support Types: Provide support of category specified, of type having features required to match fixture.

D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

2.09 INSULATION KITS

A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install fixtures, trim and supports in accordance with manufacturer’s installation instructions.

3.02 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
   1. Carriers for following fixtures:
      a. Wall hanging lavatories
      b. Wall hanging electric water coolers and drinking fountains.
      c. Wall-hanging fixtures supported from wall construction.

2. Chair carriers for the following fixtures:
   a. Wall-hanging lavatories and sinks.
   b. Wall-hanging drinking fountains and electric water coolers.
3. Heavy-duty chair carriers for the following fixtures:
   a. Accessible lavatories.
   b. Fixtures where specified.
4. Reinforcement for the following fixtures:
   a. Floor-mounted lavatories required to be secured to wall.
   b. Floor-mounted sinks required to be secured to wall.
   c. Recessed, box-mounted electric water coolers.
   d. Wall mounted and mop sink faucets.

3.03 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.

B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

C. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.

E. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

F. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

G. Fasten wall-mounted fittings to reinforcement built into walls.

H. Fasten counter-mounting-type plumbing fixtures to casework.

I. Secure supplies behind wall or within wall pipe space, providing rigid installation.

J. Set mop basins in leveling bed of cement grout.

K. Install stop valve in an accessible location in each water supply to each fixture.

L. Install trap on fixture outlet except for fixtures having integral trap.

M. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

N. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.

O. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
   2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.06 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

D. Replace washers of leaking and dripping faucets and stops.

E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

F. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.

G. Review the data in Operating and Maintenance Manuals. Refer to Division 01 Section "Project Closeout."

H. Set each shower valve temperature limit stop to 110ºF. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium. Provide the architect a report and schedule indicating the hot, cold and mixed maximum water temperature at each shower.

3.07 FIXTURE SCHEDULE

A. Provide plumbing fixtures as specified on the drawings.

B. Install rough-in for plumbing fixtures as scheduled on the drawings.

3.08 MOUNTING HEIGHTS SCHEDULE:

A. Refer to the architectural drawings for plumbing fixture mounting heights. Unless indicated otherwise, install plumbing fixtures with the mounting heights as listed below with final approval by the Architect:

FIXTURE	MOUNTING HEIGHT
Lavatory or Sink	
Standard Height31" floor to rim	
ADA Accessible	34" floor to rim
Child Height	24” floor to rim
Water Closet	
Standard	15" floor to rim
ADA Accessible	17” to 19" floor to top of seat
Child Height	10” floor to rim
Water Cooler or Drinking Fountain	
Standard Height	41" floor to spout
ADA Accessible	36" floor to spout
Child height	30" floor to spout
Janitor’s Sink Faucet Fittings	42” floor to centerline
Hose Bibbs	36” AFF to centerline
Non Freeze Wall Hydrant	18” AFG to centerline

END OF SECTION 224000

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SECTION 227000
NATURAL GAS SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
   1. Pipes, fittings, and specialties.
   2. Special duty valves.
   3. Pressure regulators.
   4. Service meters.

B. Contractors Option:
   1. The Division 22 contractor may provide mechanically joined joints for natural gas systems to connect couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, welded, threaded or flanged piping methods. Mechanically joined natural gas systems where used shall be provided in compliance with specification Section 227011 “Mechanically Joined Natural Gas Systems”.

C. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

D. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
   2. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls.
   3. Division 9 Section "Painting," for materials and methods for painting pipe.
   4. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
   5. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges, and mechanical sleeve seals.
   6. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
   7. Division 26 Section “Common Work Results for Electrical” required electrical devices.

E. Gas pressures for systems specified in this Section are limited to 5 psig.

1.02 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.

D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.03 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.

C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."

D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

F. Test reports specified in Part 3 below.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:
1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.
2. 2023 International Fuel Gas Code

D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.

E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

1.05 SPARE PARTS

A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
   1. Gas Ball Valves – 2" and Smaller:
      a. Apollo Valves # 77F-1XX-01
      b. Hammond Valve # 8901
      c. Milwaukee Valve # BA-475B
      d. Nibco Inc. # T-FP 600A
      e. Watts # FBV-3C
   2. Gas Ball Valves – 2-1/2" to 4":
      a. Apollo Valve # 77F-1XX-01
      b. Hammond Valve # 8901
      c. Milwaukee Valve # BA-475B
      d. Nibco Inc. # T-FP 600A
   3. CSA Listed Gas Pressure Regulators
      a. Pietro-Fiorentini
   4. Semi-rigid Corrugated Stainless Steel Tubing
      a. Omegaflex, Inc. TracPipe
      b. TiteFlex corp. "Gastite"
   5. Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing
      a. Omegaflex, Inc. TracPipe II
   6. Polyethylene Pipe and Pipe Fittings:
      a. Cresline Plastic Pipe Co. PE 2708
      b. Charter Plastics PE 2708
      c. Chevron Phillips DriscoPlex Series 6500
      d. JM Eagle "MDPE Yellow Gas"
   7. Polyethylene to Steel Pipe Transition Fittings:
      a. Perfection Corporation
      b. R.W. Lyall
      c. Central Plastics
   8. Gas Meters:
      a. American Meter Company
      b. Schlumberger / Acteris
      c. Roots
   9. Insect Screens
      a. Northtown Pipe Protection Products "BUGSCRN Series"
   10. Gas Relief Vents
      a. Richards "GV Series"

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.

B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, (Type E electric-resistance welded or Type S

seamless, black steel pipe, beveled ends).

2.03 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
   1. 1-1/4" and smaller shall be socket type
   2. 1-1/2" and larger shall be butt weld type.

C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.

D. Plastic Fittings: Medium density polyethylene socket fusion fittings, meeting ASTM D 2513 compatible with the piping system.

E. Transition Fittings – Steel to Polyethylene: Factory assembled and pressure tested one piece design, with steel half of Schedule 40 steel pipe with beveled edge for welding and polyethylene half shall be of ample length for making welds. Steel pipe shall have epoxy protective coating.

F. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.

G. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

2.04 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

B. Joint Compound: Suitable for the gas being handled.

C. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.05 PIPING SPECIALTIES

A. Gas Meters: Diaphragm-type, positive displacement gas meters with aluminum cases, temperature compensated, with internal corrosion-resistant components; threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for gas working pressures, specific gravity, and volume flow indicated.

B. Gas Meters: Rotary-type, positive displacement gas meters meeting ASTM B109.3 with aluminum cases with maximum operating pressure of 175 psig, temperature compensated, with sealed mechanical totalizer, internal corrosion-resistant components and oil free design; threaded ends for 1-1/2 inch and smaller, flanged ends for 2 inch and larger; for gas working pressures, specific gravity, and volume flow indicated.

C. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:
   1. overall thickness; 20 mils;

2. synthetic adhesive;
3. water vapor transmission rate, gallons per 100 square inch: 0.10 or less.
4. water absorption, percent: 0.02 or less.
5. Prime pipe and fittings with a compatible primer prior to application of tape.

D. Strike Plates: 16 gauge carbon steel, tested and listed by CSA International.

E. In wall Strike Protection Hose: UL listed spiral wound interlocking galvanized steel reduced wall flexible conduit.

F. Nonmetallic Watertight Conduit: Schedule 80 rigid PVC, UL 651, with fittings to match to conduit type and material.

G. Multiple Port Manifolds: ANSI LC1b, plastic coated malleable iron, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International.

2.06 VALVES

A. Gas Ball Valves – 2” and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.

B. Gas Ball Valves – 2-1/2” to 4”: Standard port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 400 WOG, UL listed for natural gas service.

C. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent, vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.
1. CSA listed for 2 PSI gas systems
2. CSA listed for 5 PSI gas systems with factory overpressure protection device.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install pipe, fittings, valves and specialties in accordance with manufacturer’s installation instructions.

3.02 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.03 PIPE APPLICATIONS

A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints

for 2-1/2 inch and larger.

B. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

C. Install pre-sleeved vent capable semi-rigid corrugated stainless steel tubing for single runs tubing underslab inside of building.

3.04 PIPING INSTALLATION

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: As specified below:
   1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
   2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.
   3. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
   4. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
   5. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.

D. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section “Common Work Results for Plumbing” for special sealers and materials.

E. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section “Common Work Results for Plumbing” for additional information.

F. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Material and Methods” for additional information.

G. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.
   1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3” length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2” above the roof or floor

readily accessible to permit cleaning and emptying.

2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

H. Use fittings for all changes in direction and all branch connections.

I. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

J. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

K. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

L. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

M. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

N. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

O. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

P. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

Q. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section “Basic Piping Materials and Methods”.

R. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Dielectric unions and flanges are specified in Section “Basic Piping Materials and Methods”.

S. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

T. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

U. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."

V. Paint Exposed Outdoor Gas Piping: Cleaning and painting of exposed outdoor gas piping is specified in Division 9 Section "Painting".

1. Final color per the architect.

W. Semi-rigid Corrugated Stainless Steel Tubing:

1. Install through floors, walls and ceilings with an opening at least ½” larger than the outside diameter of the tubing.

2. Install changes in direction with a minimum bend radius per the manufacturer's recommendations to avoid over stressing the tubing or fittings. Replace tubing that has been installed with tight bends, kinks, twists or stretches with new.
3. Provide striker plates within 3" of joist, ceiling, or floor and per the manufacturer's recommendations to protect tubing installed beneath, or along floor support members or though floor support members to protect concealed piping from puncture.
4. Install tubing within partition walls between wall studs hanging freely and provide striker plates where the tubing is attached or constrained at studs or other retaining type structures to prevent the possibility of being punctured by a 3" long nails.
5. Install termination outlets with sufficient clearance from ceilings, walls and floors to permit the use of a suitably sized pipe wrench without straining or bending the tubing. Provide a strike plate or encase the tubing in a strike protection hose to protect the tubing where movement is restricted due to the termination outlet. Concealed fitting are permitted when the piping is installed within a strike protection hose.
6. Install manifolds in an accessible location.
7. Install tubing under concrete slab on grade within buildings provide with either factory installed pre-sleeved vent pipe or conduit at least ½" larger than the outside diameter of the tubing. Install tubing underslab as one piece, with no splices - concealed fittings are not permitted. Tubing is not permitted to be directly embedded within concrete.
8. Install tubing underground outside of building and provide with either factory installed pre-sleeved vent pipe or conduit at least ½" larger than the outside diameter of the tubing. Provide minimum burial depth of 18". Install conduit to extend 12" minimum above grade. Install tubing underground as one piece, with no splices - concealed fittings is not permitted. Attach to the building or structure within 12" of entering or leaving conduit. Provide a support post where the building or structure is not available for support.
9. Provide a pipe sleeve at least ½" larger than the outside diameter of the tubing within 6 feet of floor / grade to protect exposed piping either inside building or outside building.
10. Fittings with auto-flare ends with stainless steel inserts: Provide shrink sleeves at mechanical joints and associated exposed metal tubing for protection from damage.
11. Fittings with double wall flare with Jacket Lock™, mechanical capture of the jacket: Secure jacket with fitting at mechanical joints. Where jacket is not captured by fitting, provide shrink sleeves at associated exposed metal tubing for protection from damage.
12. Provide transition fittings for steel to tubing in accessible location to permit visual inspection.
13. Tubing is not approved for installation as a gas appliance connector for final connection to movable gas appliances or equipment. Do not directly connect tubing to either movable or non-movable equipment or appliances.
14. Install tubing underslab inside of building with pre-sleeved vent capable semi-rigid corrugated stainless steel tubing. Provide minimum burial depth of 18". Install tubing underground as one piece, with no splices - concealed fittings is not permitted. Extend to above slab 12" above floor at both ends.
    a. Provide copper tube vent with braised joints from vent connection in pre-sleeved vent capable semi-rigid corrugated stainless steel tubing to the outdoors where indicated on the drawings.

X. Install plastic pipe underground with socket weld plastic joints. Use transition fittings for joining steel to plastic pipe. Installation and pipe bedding shall be per the manufacturer's published installation recommendations.

3.05 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:
1. Adjustable clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2" and larger for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
4. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.
5. Provide roll hangers for individual horizontal runs 100 feet or longer.
6. Provide roll hangers for individual horizontal runs 20 feet or longer for exposed piping installed on roofs.

Nom. Pipe Size in Inches	Max Span In Feet	Min. Rod Dia. - Inches
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	3/8
4	10	3/8
6	10	1/2
8	10	3/4

C. Support vertical piping at every floor.

D. Support gas piping within 12" of each elbow or tee and for gas piping 2-1/2" and larger at each valve or pressure regulator.

E. Support gas piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Support pipe at a minimum 7" above the roof.

3.06 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
2. CAUTION: Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.
3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.

4. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
   2. Align threads at point of assembly.
   3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
   4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
   5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

E. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer's recommendations.

F. Semi-rigid Corrugated Stainless Steel Tubing: Joints shall be made by a qualified and approved operator in accordance with pipe manufacturer's recommendations.

3.07 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.08 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install the emergency natural gas shutoff valve furnished with exhaust hood fire extinguishing system in an accessible location.

C. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.

D. Installation of Gas Pressure Regulators:
   1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
   2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
   3. Install line pressure regulators a minimum of 10'-0" upstream of each condensing boiler

or water heater connection.

4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18" above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1" long schedule 40 black steel nipple.
    a. Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator dome in the horizontal or vertically upright with factory breather plug.
7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18" above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:
    a. 10 feet developed length = size vent one pipe size larger than relief vent outlet size
    b. 20 feet developed length = size vent two pipe size larger than relief vent outlet size
    c. 30 feet developed length = size vent three pipe size larger than relief vent outlet size
    d. 40 feet developed length = size vent four pipe size larger than relief vent outlet size

3.09 TERMINAL EQUIPMENT CONNECTIONS

A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.

B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

3.10 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION 227000

SECTION 227010
MECHANICALLY JOINED NATURAL GAS PIPING SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes mechanically joined fittings and valves for distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
   1. Fittings.

B. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

C. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 22 Section "Natural Gas Systems," for valves, hangers, natural gas systems and installation requirements.

D. Gas pressures for systems specified in this Section are limited to 5 psig.

1.02 SUBMITTALS

A. Product data for each mechanically joined gas pipe fitting. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Maintenance data for mechanically joined gas pipe fittings, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

C. Installer qualification certificates, certifying that installers comply with the quality requirements specified under "Quality Assurance" below.

D. Test reports specified in Part 3 below.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Installation of mechanically joined fittings shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Local Gas Utility Requirements: Installation of mechanically joined fittings shall comply with local gas utility installation rules and regulations.

C. Mechanically joined fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

D. Obtain training from the mechanically joined fittings manufacturer for all workers that will be installing or handling the mechanically joined fittings.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
   1. Mechanically Joined Fittings:
      a. Viega “Mega-Press G Fittings”
      b. Apollo “PowerPress”
      c. Mueller Streamline STL

2.02 FITTINGS

A. Mechanically Joined Fittings: ½ inch through 4 inch meeting ANSI LC4-2012 /CSA 6.32-2012 2nd Edition with zinc/nickel coating, HNBR sealing element, 420 stainless steel grip ring, 304 stainless steel separator ring, and Smart Connect (SC) Feature that allows the joint to leak if not properly sealed. Fittings shall be for use with IPS schedule 10 thru schedule 40 carbon steel, or galvanized pipe meeting ASTM A53. Fittings shall have temperature and pressure rating of -40F to 180F at a maximum operating pressure of 125 psi.

2.03 VALVES

A. Mechanically Joined Gas Ball Valves: ½ inch through 2 inch carbon steel body meeting ASTM A216 or bronze body meeting ASTM B584, with full port 316 stainless steel ball meeting ASTM A276, blowout-proof stem, with replaceable "Teflon" or "PTFE" seats and seals, solder ends and vinyl-covered steel handle. Provide with mechanically joined ends meeting ASTM LC4 with HNBR O-ring.
   1. Apollo “PowerPress” # 89FVH4 series
   2. Viega “MegaPress G” series #6675

B. Mechanically Joined Gas Ball Valves: 2-1/2 inch through 4 inch carbon steel body meeting ASTM A216 with zinc-nickel coating, with full port chrome plated brass ball, blowout-proof stem, with replaceable "Teflon" or "PTFE" seats and seals, solder ends and vinyl-covered steel handle. Provide with mechanically joined ends meeting ASTM LC4 with HNBR O-ring.
   1. Viega “MegaPress G” series #6675XL

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Install fittings and valves in accordance with manufacturer’s installation instructions.

3.02 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.03 PIPE APPLICATIONS

A. Install above floor steel pipe with mechanically joined fittings for pipe 1/2 inch and larger up to 4".

3.04 PIPING INSTALLATION

A. Piping Installation requirements are specified in Division 22 Section "Natural Gas Systems".

3.05 PIPE JOINT CONSTRUCTION

A. Joint materials and installation requirements are specified in Division 22 Section "Natural Gas Systems".

B. Joints for Mechanically Joined Fittings: Comply with the manufacturer's installation instructions and Requirements:
1. Cut pipe ends at right angle (square) to the pipe.
2. Ream pipe ends with chamfer.
3. Remove paint, lacquer, grease, oil or dirt from the pipe end with an abrasive cloth, or with the "Ridgid MegaPress" pipe end prep tool.
4. Visually examine the fitting sealing element to ensure there is no damage.
5. Utilize a "Viega MegaPress Insertion Depth Inspection Gauge" to mark the pipe wall, with a felt tip pen, at the appropriate location, or insert the pipe fully into the fitting and mark the pipe wall at the face of the fitting.
6. Verify the pipe is fully inserted into the fitting prior to pressing the joint.
7. Install mechanically joined fittings using "Ridgid" MegaPress Tools.

3.06 VALVE APPLICATIONS

A. Valves are specified in Division 22 Section "Natural Gas Systems".

B. Valves can be installed with screwed joints for 2" and smaller and flanged joints for 2-1/2" and larger. Or, valves can be provided with mechanically joined fitting adapters and the joints installed as specified herein.

3.07 VALVE INSTALLATIONS

A. Valve installation requirements are specified in Division 22 Section "Natural Gas Systems".

3.08 FIELD QUALITY CONTROL

A. Field quality control requirements are specified in Division 22 Section "Natural Gas Systems".

B. Installing contractor shall schedule training session with the mechanically joined fittings manufacturer at project site for all workers that will be installing or handling mechanically joined fittings. Submit certification letter along with list of certified attendees to Architect within 30-days of mobilization. Include copy of certification letter with closeout documents. Mechanically joined fittings manufacturer shall provide certification training to the contractor without cost and without additional cost to the Owner.

C. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

D. Manufacturer's Piping Test: Provide two-step test process as follows:
   1. Pressurize the system between 0.5 psi and 45 psi with air or dry nitrogen.
   2. If the system does not hold pressure, walk the system and check for un-pressed fittings.
   3. If un-pressed fittings are found, ensure the pipe is fully inserted into the fitting and properly marked prior to pressing the joint.
   4. If failed joints are fond, cut out the failed fitting and replace with new as specified herein.
   5. After appropriate repairs have been made, test the system per local code, not to exceed 200 psig.

END OF SECTION 227010

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DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING SPECIFICATION

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SECTION 230010
GENERAL MECHANICAL REQUIREMENTS

PART 1 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.02 QUALITY ASSURANCE

A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.03 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
UBC	Uniform Building Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
FGI	Facilities Guideline Institute
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act

PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

1.04 DEFINITIONS

A. General:
1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use. When ‘furnish’, ‘install’, ‘perform’, or ’provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    a. 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.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

9. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Bedding: Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
6. Building Fill: Building fill as used in this section refers to borrowed fill material of rock 1” and larger used to fill foundation excavations

1.05 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate the work with other contractors and subcontractors so that various components of the mechanical systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.06 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
   1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
   2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
   3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
   4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
   6. Indicate required installation sequence to minimize conflicts between entities.
   7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.

B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
   1. Clearly identify all required working clearances and access provisions required for installation and maintenance.

2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
4. Include work provided by others routed through the equipment rooms.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.07 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.08 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.

C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.

E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

I. Refer to individual Sections for additional submittal requirements.

J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Submittals shall contain the following information:
   1. The project name.
   2. The applicable specification section and paragraph.
   3. Equipment identification acronym as used on the drawings.
   4. The submittal date.
   5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
   6. Submittals not so identified will be returned to the Contractor without action.

L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.

M. Provide welders’ qualification certificates.

1.09 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.10 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:
   1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
   2. The burden of proof of the merit of the proposed substitution is upon the proposer.
   3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
      a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
      b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
      c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
      d. Same warranty will be furnished for proposed substitution as for specified Work.
      e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
      f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:
   1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
   2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.

3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer’s review, and for the Owner’s use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in each individual Section.

F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer’s designated representative.

1.12 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

1.13 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.14 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.15 PAINTING

A. Exposed ductwork and ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Contractor using materials and methods as specified under Division 09 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.16 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of their own tools, material and equipment.

1.17 GUARANTEES AND WARRANTIES

A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:
   1. Piping shall be free from obstructions, holes or breaks of any nature.
   2. Insulation shall be effective.
   3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.18 TEMPORARY FACILITIES

A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
   1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
   2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
   1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
   2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.19 PROJECT CONDITIONS

A. Conditions Affecting Work In Existing Buildings:
   1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting their bid to determine the nature and extent of work involved.
   2. Work in the existing building shall be scheduled with the Owner.
   3. Certain demolition work must be performed prior to the remodeling. The Mechanical Contractor shall perform the demolition which involves Mechanical systems, equipment, piping, equipment supports or foundations and materials.
   4. Mechanical Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Mechanical Contractor during this demolition shall become their property and shall be removed by the Mechanical Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
   5. Mechanical Contractor shall relocate and reconnect Mechanical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Mechanical equipment or materials are removed, the Mechanical Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
   6. General Contractor shall install finish material.
   7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
   8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   9. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 PRODUCTS AND MATERIALS

2.01 NOT USED

2.02 SOIL MATERIALS

A. Bedding Material: Provide clean sand, pea gravel or flowable fill material (per the geotechnical or structural engineer's recommendations).

B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially graded crushed aggregate. Corrosive fill materials shall be not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and shall be free of debris, waste, frozen materials, vegetable and other deleterious matter.

C. Drainage Fill: Provide washed, evenly graded mixture of 3/4" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.

D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

PART 3 EXECUTION

3.01 PERMITS

A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.02 EXISTING UTILITIES

A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.

B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.

C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.

E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.03 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation and Trenching shall be in conformance with applicable Division and section of the General Specifications.

C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

E. Erect barricades around excavations and trenches for safety. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

F. Slope sides of excavations and trenches to comply with Geotechnical Report, local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations and trenches regardless of time period excavations and trenches will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering of Excavation and Trenches: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
   1. Do not allow water to accumulate in excavation or trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations and trenches.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas.
   3. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations and trenches. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to

permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of sand or pea gravel prior to installation of pipe. Provide a minimum of 6 inches of sand or pea gravel cushion between rock bearing surface and pipe.
5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment bedding on undisturbed soil.

M. Cold Weather Protection: Protect excavation and trench bottoms against freezing when atmospheric temperature is less than 35°F.

N. Bedding:

1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below.
2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.

O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under pipes, use bedding materials in layers to 6 inches above top of the pipe.
2. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
3. Under building slabs, use subbase materials.
4. Under piping and equipment, use bedding and subbase materials over rock bearing surface and for correction of unauthorized excavation.
5. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete protection slab. After installation and testing of pipes, provide a 4-inch thick concrete protection top slab prior to backfilling and placement of roadway subbase. Contractor shall coordinate with local AHJ as to requirements for colored concrete in this application.
6. Other areas, use excavated or borrowed materials where applicable.
7. Backfill excavations as promptly as work permits, but not until completion of the following:

a. Inspection, testing, approval, and locations of underground utilities have been recorded.
b. Removal of concrete formwork.
c. Removal of shoring and bracing, and backfilling of voids.
d. Removal of trash and debris.

8. Where gravel fill (drainage fill) is used as building fill material in lieu of natural soils, provide filter fabric material to line the trench to support the bedding fill material and subgrade materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
9. Ductwork under slab shall be backfilled with a minimum of 4" bedding material on all sides for protection from soils (per Code). Subbase materials shall be utilized above the bedding material to the subgrade level.
    a. If concrete encasement is required, a minimum of 4" thickness all sides shall be provided unless otherwise noted. Contractor shall provide hold down straps as per manufacturer's recommendations.
    b. If a concrete ballast pad is required, size of ballast pad shall be as noted on the drawings or as per manufacturer's recommendations.

P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

Q. Subgrade Placement and Compaction: Place subgrade backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

R. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

S. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

T. Placement and Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is disallowed as an acceptable process for compaction of excavations or trenches.
2. For vertical and/or diagonal pipe installations greater than 1/2" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
3. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative

dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
5. Compaction: control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
6. Percentage of maximum density requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    a. Areas under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material listed, or 95 percent relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    c. Other Areas: Compact top 6 inches of subgrade and each layer of subbase backfill or fill material to 90 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

U. Subsidence: Where subsidence occurs at mechanical installation excavations and trenches during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.04 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.05 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.06 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
   1. Submit complete Operation and Maintenance Manuals.
   2. Submit complete Record Drawings.
   3. Perform special inspections as required in each individual Section.
   4. Start-up testing of systems.
   5. Removal of temporary facilities from the site.
   6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, the Contractor shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. The Contractor shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 230010

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 230015
ELECTRICAL COORDINATION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.02 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.03 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL” for specification of motor connections.

C. Refer to Division 26, "ENCLOSED CONTROLLERS" for specification of motor starters.

D. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

PART 3 EXECUTION

3.01 CONTRACTOR COORDINATION

A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Motor control centers	DIV26	DIV26	DIV26	DIV23t
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23t
Overload heaters	DIV23m	DIV26	---	---
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Variable speed drives	DIV23m	DIV23m	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m	DIV26	DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Thermostats (low voltage)	DIV23t	DIV23t	---	DIV23t
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Time switches (for mechanical equipment)	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Temperature control panels (housing controllers)	DIV23t	DIV23t	DIV26	DIV23t
Building controllers, advanced application controllers, and application specific controllers	DIV23t	DIV23t	DIV23t	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t
Pressure independent control valves	DIV23t	DIV23m	DIV23t	DIV23t
Damper operators, PE & switches	DIV23t	DIV23t	DIV23t	DIV23t
Smoke dampers and combination fire/smoke dampers	DIV23m	DIV23m	DIV26	DIV28
Smoke dampers for smoke control system	DIV23t	DIV23m	DIV26	DIV23t/28
Control dampers	DIV23t	DIV23m	DIV26	DIV23t
Duct Smoke detectors	DIV28	DIV23m	DIV28	DIV28
Refrigeration equipment and controls	DIV23m	DIV23m	DIV26	DIV23t
Pushbutton stations and connections	DIV23m	DIV23m	DIV26	DIV23t
Temporary heating connections	DIV23m	DIV23m	DIV26	DIV23m
Interlocks between air handling units and exhaust fans	---	---	---	DIV23m
Interlocks between HVAC fans and damper operators	---	---	DIV26	DIV23t
Interlocks between kitchen exhaust hood(s) and make-up air unit(s)	---	---	---	DIV23m

DIV23m = Mechanical Contractor
DIV23t = Temperature Controls Sub-Contractor
DIV26 = Electrical Contractor
DIV28 = Electronic Safety and Security

END OF SECTION 230015

SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.

B. Mechanical equipment nameplate data.

C. Concrete for bases and housekeeping pads.

D. Non-shrink grout for equipment installations.

E. Sleeves for mechanical penetrations.

F. Drip Pans with detection.

G. Miscellaneous metals for support of mechanical materials and equipment.

H. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.

I. Joint sealers for sealing around mechanical materials and equipment.

J. Sealing penetrations through noise critical spaces.

K. Plenum insulation for enclosure of combustible items located within fire-rated plenums.

L. Firestopping

1.02 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
   1. Provide UL Label on each fire-rated access door.

C. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness

to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.03 NOISE CRITICAL SPACES

A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

Space	RC Levels
Sanctuary	25
Choir Risers	25
Stage	25
Sound/Lighting Control Rooms	25
A/V Spaces	25
TV Production Studio	25
Drama Theatre	25
Music Teaching Studios	25
Teleconference Rooms	25
Meeting/Banquet Rooms	30
Conference Rooms	30
Courtrooms	30

PART 2 PRODUCTS AND MATERIALS

2.01 ACCESS TO EQUIPMENT

A. Refer to Architectural documents for specification of Access Panels and Access Doors.

B. Manufacturers:
1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

C. Access Doors:
1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
2. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
   a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wideexposed perimeter flange and adjustable metal masonry anchors.

b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.

3. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
   a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
4. Locking Devices: Flush, screwdriver-operated cam locks.
5. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.02 MECHANICAL EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.03 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted mechanical equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.

B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.

C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.

D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24” on center with a minimum of two bars each direction.

E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.

F. Concrete equipment bases and housekeeping pads shall have height as specified on the drawings or minimum height if not specified in accordance with the following table:

Equipment	Minimum Height
Furnaces, Exterior Equipment Less than or equal to 20 tons and Other Equipment Not Listed	3-1/2”
Air Handling Units w/TSP less than or equal to 3.5”, Boilers (See Note 1)	3-1/2”
Chillers, Condensate Pumps, Base Mounted Pumps up to 30 HP, Air Handling Units w/TSP greater than 3.5”, All Vertical Inline Pumps, (See Note 1)	5-1/2”
Base Mounted Pumps 30 HP to 75 HP (See Note 1)	7-1/4”
Base Mounted Pumps greater than 75 HP (See Note 1)	11-1/4”

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.
2. Coordinate final pad heights for air handling units with required condensate trap depths. Increase pad heights as needed to allow for unit trap height and required slope to drain.

2.04 GROUT

A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.

B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.

C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.05 PENETRATIONS

A. Sleeves:
   1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
   2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.06 DRIP PANS

A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2” lapped and soldered joints. Drip pan shall have a depth of 2” and a width of 6” in addition to the diameter of the associated pipe. Provide 3/4” galvanized pipe with male NPT outlet at low point of drip pan.

Connect ¾" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.

B. Drip pan supports shall be ¼" X 2" galvanized bar stock welded to the drip pan without holes. Provide ¼" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.

C. Flood Detector: Flood detector switch utilizing hydrophilic pad and stainless steel sensor array to detect moisture. Switch shall be provided with integral feet to prevent pad from contacting the pan. Provide with solid state electronics and double throw relay to allow switch to shut down unit and provide an auxiliary alarm output.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diversitech
      b. RCT/Aquaguard
      c. Approved equivalent

2.07 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.08 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

2.09 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Nonacid Curing Sealer: One-part, nonacid-curing, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
   1. Manufacturers:
      a. Dow Corning, Dowsil 790.

b. Dow Corning, Dowsil 795.
c. GE, Silglaze II SCS 2350.
d. GE, Silpruf SCS 2000.
e. Owens Corning, Energy Complete.
f. Pecora, 864 NST.
g. Tremco, Spectrem 1.
h. Tremco, Spectrem 2.

D. High Humidity Sealer: One-part, mildew-resistant, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
1. Manufacturers:
a. Dow Corning, Dowsil 786.
b. GE, Momentum SCS1700.
c. Pecora, 898 Silicone NST.

E. Hybrid Joint Sealer: One-part, non-sag, paintable complying with ASTM C920, Type S, Grade NS, Class 50, recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent.
1. Manufacturers:
a. BASF, MasterSeal NP 100.
b. Pecora, DyanTrol I-XL.
c. Tremco, Dymonic FC.

F. Acrylic Latex Joint Sealer: One-part, non-sag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C834, Type OP, Grade NF, recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
1. Manufacturers:
a. Pecora, AC-20
b. Sherwin Williams 950A
c. Tremco, Tremflex 834

2.10 PLENUM INSULATION

A. General: Combustible materials including, but not limited to, plastic pipe and plastic-coated cables that do not meet the minimum combustibility requirements of the applicable building codes may be installed in fire-rated plenums when enclosed within high-temperature insulation blanket where approved by the authority having jurisdiction.

B. Material: Provide light weight, high temperature, inorganic fiber blanket enhanced for biosolubility and encapsulated with a scrim-reinforced foil.

C. Certification: Plenum insulation shall have an encapsulated flame spread rating less than 25 and a smoke developed rating of less than 50. The product shall be UL 1887 (Modified) listed, certified by ASTM E-136 for Non-combustibility and ASTM E-84/UL 723 for Surface Burning Characteristics.

D. Physical Properties: Plenum insulation shall be single, minimum 1/2" thick layer with a density of 2 to 8 pounds per cubic foot.

E. Acceptable Manufacturers and Products:
1. 3M Fire Barrier Plenum Wrap 5A+.
2. ETS Schaefer Plenumshield Blanket.
3. Knauf Earthwool 1000° Pipe Insulation with ECOSE Technology.
4. Morgan Advanced Materials – Thermal Ceramics FireMaster PlenumWrap+.
5. Owens Corning Pipe Insulation SSL II with ASJ Max Jacket.
6. Unifrax FyreWrap 0.5 Plenum Insulation.

2.11 FIRESTOPPING

A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E814, or other NRTL acceptable to AHJ.

B. Manufacturers:
1. 3M Corp., Fire Barrier Sealant.
2. Hilti.
3. Owens Corning, Firestopping Insulation.
4. Pecora, AC-20 FTR.
5. RectorSeal.
6. Specified Technologies Inc., Firestop.
7. USG SHEETROCK Firecode Compound.
8. Tremco, Tremstop Fyre-Sil.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer's instructions.

3.02 INSTALLATION OF ACCESS DOORS

A. Provide access doors for all concealed equipment and duct and piping accessories that require service where indicated or as required, except where above lay-in ceilings. Refer to Section "Identification for HVAC Piping and Equipment" for labeling of access doors.

B. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.

C. Access doors must be of the proper construction for type of construction where installed.

D. The exact location of all access doors shall be verified with the Architect prior to installation.

E. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

F. Adjust hardware and panels after installation for proper operation.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.04 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not 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 members.

C. Attach to substrates as required to support applied loads.

3.05 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.06 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
   1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
   2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.07 PENETRATIONS:

A. New Construction:
   1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

G. All sleeves shall be of ample size to allow for movement of conduit, duct or pipe and insulation through the sleeves without damage to the insulation.

H. Cut sleeves to length for mounting flush with both surfaces of walls.

I. Extend sleeves installed in floors 2 inches above finished floor level.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

K. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

L. All circular and oval openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 23 Section “Basic Piping Materials and Methods”. All rectangular openings through underground exterior walls shall be flanged and flashed with non-corrosive material on each side and the gap sealed with weatherproof sealant.

3.08 DRIP PANS

A. Provide drip pans in locations indicated on drawings.

B. Provide drip pans under piping or equipment that is installed in spaces that have sensitive electronics/electrical equipment such as electrical, IT/AV, telecom, data equipment, elevator machinery rooms, etc. Obtain approval from the Architect prior to installation.

C. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.

D. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.

E. Provide drip pan supports every 4’-0”.

F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.

G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.

H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section “Common Work Results for Electrical”. Disconnects are specified in Division 26 Section “Enclosed Switches and Circuit Breakers”

I. Place flood detector in the lowest location in the drip pan. Interlock detector with the HVAC equipment per manufacturer’s recommendations.

J. Wire flood detector to remote alarm, Diversitech Universal Alarm or equivalent. Coordinate location of the remote alarm with building owner prior to installation.

K. Coordinate interlock of “Water Present” alarm and “Cable Fault” alarm with building automation system. Refer to Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system and low voltage power wiring.

3.09 PLENUM INSULATION

A. General: Plenum insulation shall be installed as a single layer encapsulation applied directly on the surface of combustible items within fire-rated plenums where permitted by the local authority having jurisdiction

B. Overlap: Provide a minimum 1” perimeter and longitudinal overlap at all seams and joints. Seal all cut edges with aluminum foil tape. There shall be no exposed fiber.

C. Secure Attachment: Securely attach insulation using stainless steel tie wire or banding at locations and intervals as recommended by the manufacturer. The entire installation shall comply with the manufacturer’s written installation instructions.

D. Approval: Plenum insulation shall not be installed where not allowed by local authority having jurisdiction. Do not install combustible material within fire-rated plenums where the use of plenum insulation is not approved.

END OF SECTION 230500

SECTION 230510
BASIC PIPING MATERIALS AND METHODS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Joining materials.

B. Escutcheons.

C. Nipples.

D. Unions.

E. Dielectric unions.

F. Dielectric waterway fittings.

G. Dielectric flanges and flange kits.

H. Mechanical sleeve seals.

I. Pipe roof curbs.

1.02 SUBMITTALS

A. Refer to Division 01 and Division 23 Section “General Mechanical Requirements” for administrative and procedural requirements for submittals.

B. Product Data, including, rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.

C. Quality Assurance Submittals: Submit welders' certificates specified in Article “Quality Assurance” below.

D. Piping Schedule: Submit a piping schedule that states the material being proposed for each piping system application in the project including manufacturer’s catalog information, pipe materials, sizes, fittings, Type, Grade, Schedule, applicable ASTM standard, and connection method(s).

E. Submit a schedule of dissimilar metal joints and dielectric flanges, flange kits, unions, or waterway fittings. Include proposed product, joint type materials, and connection method to isolate dissimilar metals. Refer to the individual Division 23 piping system specification sections for piping materials and fittings relative to that particular system and additional requirements.

F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

G. Manufacturer's Installation Instructions: Indicate hanging and support methods and joining procedures.

H. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

I. Shop Drawings: Include detailed fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.

J. Coordination Drawings: Include piping layout, 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. Other building services.
3. Structural members.

K. As-built drawings for each piping system in electronic and PDF format.

L. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.03 QUALITY ASSURANCE

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code (BPVC), Section IX, “Welding, Brazing, and Fusing Qualifications.”

B. Comply with ASME B31.9 - Building Services Piping, most recent edition.

C. Comply with American Welding Society (AWS), Welding Handbook, most recent edition.

D. Soldering and Brazing procedures shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration.

E. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ASME, and ANSI standards.

F. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

C. Refer to the individual piping system specification sections in Division 23 for additional requirements.

PART 2 PRODUCTS AND MATERIALS

2.01 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

2.02 JOINING MATERIALS

A. Refer to individual Division 23 Piping Sections for special joining materials not listed below.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

C. Welding Materials: Comply with AWS D10.12 and Section II, Part C, ASME BPVC for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

D. Brazing Filler Metals: Comply with SFA-5.8, Section II, ASME BPVC for brazing filler metal materials appropriate for the materials being joined.
   1. AWS A5.8, Classification BAg–5:
      a. Silver (Ag) 44.0 – 46.0 percent.
      b. Zinc (Z) 23.0 – 27.0 percent.
      c. Copper (Cu) 29.0 – 31.0 percent.
   2. AWS A5.8, Classification BCuP–5:
      a. Phosphorus (P) 4.8 - 5.2 percent.
      b. Silver (Ag) 14.5 - 15.5 percent.
      c. Copper (Cu) remainder.

E. Soldering Filler Metals: ASTM B32, 95-5 Tin-Antimony and water flushable flux in accordance with ASTM B813.

F. Plastic Pipe Solvent Cement:
   1. PVC: ASTM D2564.
   2. CPVC: ASTM F493.

G. Gaskets for Flanged Joints: ASME B16.21, full-faced for cast-iron flanges and raised-face for steel flanges. Select material, thickness, and type to suit the service of the piping system in which installed and which conform to their respective ASME Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.03 ESCUTCHEONS

A. Manufacturers:
   1. AWI Manufacturing.
   2. Keeney Manufacturing Company.
   3. Wal-Rich Corp.
   4. Jones Stephens Corp.
   5. Approved equal.

B. Chrome-plated, stamped-steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

2.04 NIPPLES

A. Steel: ASTM A733, made of ASTM A53, Schedule 40, black steel; Type S seamless for pipe sizes 2 inch and smaller, Type E electric-resistance welded for pipe sizes 2-1/2 inch and larger.

2.05 UNIONS:

A. Manufacturers:
1. Anvil International.
2. Hart Industries.
3. Mueller Streamline Co.
4. Victaulic Company of America.
5. Watts Regulator Co.
6. Approved equal.

B. Hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
1. Malleable-iron: ASME B16.39, class as specified in section “Hydronic Piping” for the piping system used.
2. Bronze: ASME B16.15, cast bronze body meeting ASTM B62, class as specified in section “Hydronic Piping” for the piping system used.
3. Copper: ASME B16.22 wrought copper body.
a. For hydronic systems, provide class as specified in section “Hydronic Piping” for the piping system used.
b. For refrigerant systems, provide pressure rating as required for the refrigerant type used.

2.06 DIELECTRIC UNIONS

A. Manufacturers:
1. Hart Industries.
2. Victaulic Company of America.
3. Watts Regulator Co.
4. Approved equal.

B. Factory-fabricated with cast bronze body meeting ASTM B584 and galvanized or black steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

2.07 DIELECTRIC WATERWAY FITTINGS

A. Manufacturers:
1. Victaulic Company of America (Sweat and threaded connections only).
2. Approved equal.

B. Electroplated steel, brass, bronze, or nylon encapsulated nipple, with an inert and non-corrosive, thermoplastic lining, and appropriate end connections for the pipe materials in which installed (screwed, soldered, grooved, or flanged) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

2.08 DIELECTRIC FLANGES AND FLANGE KITS

A. Manufacturers:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Pipeline Seal & Insulator, Inc.
4. Tampa Rubber & Gasket Co. Inc.
5. Watts Water Technologies.
6. Approved equal.

B. Full-faced gasket with same outside diameter and bolt hole arrangement as the flange. Conform to ANSI B16.5. Pressure rating of 200 psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.

C. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

D. Flanges: Cast bronze meeting ASTM B584, class 125 solder type or cast iron meeting ASTM A536, class 125 threaded type for low pressure service, bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.

2.09 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline/Link Seal.
2. Calpico, Inc.
3. Metraflex Co.
4. Approved equal.

B. Sleeves: Refer to Division 23 Section “Common Work Results for HVAC” for sleeve materials.

C. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.10 PIPE ROOF CURBS

A. Manufacturers:
1. AES Industries.
2. Custom Curb, Inc.
3. Pate Company.
4. Thybar.

B. Provide factory-fabricated, pipe roof curbs with the following features:
1. Factory installed treated wood nailer.
2. Welded, 18 gauge galvanized steel shell, base plate and flashing.
3. 1-1/2 inch thick, 3 pound rigid insulation.
4. Fully mitered 3-inch raised cant.
5. Cover of weather-resistant, weather-proof material.
6. Pipe collar of weather-resistant material with stainless steel pipe clamps.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer's instructions.

B. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

C. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations. Provide deep pattern escutcheons where required to conceal protruding pipe fittings.

D. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

E. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

F. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.

J. Verify final equipment locations for roughing in.

K. Use fittings for all changes in direction and all branch connections.

L. Remake leaking joints using new materials.

M. Install components with pressure rating equal to or greater than system operating pressure.

N. Piping Protection:

1. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
2. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.03 PENETRATIONS

A. Mechanical penetrations occur when piping or ductwork penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies. Reference Division 23 Section "Common Work Results for HVAC" for additional penetration requirements.

B. Above Grade Concrete or Masonry Penetrations:
   1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs.
      a. Provide Schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
      b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
      c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
         1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
         2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
      d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
   2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
   3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant.

C. Underground, Exterior-Wall Penetrations:
   1. Install cast-iron sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
   2. Use type and number of sealing elements recommended by manufacturer 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.
   3. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

D. Above Ground, Exterior Wall Penetrations:
   1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of

1/2 inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.

E. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron sleeves, extend top of sleeve minimum 1 inch above finish floor. Size sleeve for minimum 1/2 inch annular space between pipe and sleeve.
2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.
3. Pack with mineral wool and seal both ends with minimum of 1/2 inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
5. Extend bottom of sleeve below floor slab as required and secure underdeck clamp to hold sleeve rigidly in place.

F. Interior Foundation Penetrations:
1. Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.

G. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
2. Provide 1/2 inch thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2 inches above and below the concrete slab.

H. Interior Penetrations of Non-Fire-Rated Walls:
1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.

I. Fire / Smoke Rated Floor and Wall Assemblies:
1. Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer’s UL listing. Refer to Division 07 Section “Penetration Firestopping” for special sealers and materials.

J. Acoustical Barrier Penetrations:
1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section “Common Work Results

for HVAC" for noise critical spaces. The internal diameter of the sleeve shall be minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.

2. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.04 PIPE JOINT CONSTRUCTION

A. Threaded Joints:
   1. Provide tapered pipe threads for field cut threads. Cut threads full and clean using sharp dies.
   2. Ream threaded pipe ends to remove burrs and restore full inner diameter.
   3. Note the internal length of threads in fittings or valve ends and proximity of internal seat or wall to determine how far pipe should be threaded into joint.
   4. Align threads at point of assembly.
   5. Apply appropriate tape or thread compound to the male pipe threads except where dry seal threading is specified.
   6. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded. Tighten joint to leave not more than 3 threads exposed.
   7. Damaged Threads: Do not use pipe or pipe fittings with threads which are corroded or damaged.

B. Flanged Joints:
   1. Select appropriate gasket material, size, type, and thickness for service application.
   2. Install gasket concentrically positioned.
   3. Align flanges surfaces parallel.
   4. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible.
   5. Use suitable lubricants on bolt threads.
   6. Tighten bolts gradually and uniformly using torque wrench.

C. Welded Joints:
   1. Comply with the requirement in ASME Code B31.9, "Building Services Piping."
   2. Damaged Welds: Do not use pipe sections that have cracked or open welds.

D. Brazed and Soldered Joints:
   1. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
   2. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
   3. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
   4. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
   5. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making joint.
   6. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
   7. Copper-to-copper joints shall be made using BCuP-5 brazing filler metal without flux.

8. Dissimilar metals such as copper and brass shall be jointed using an appropriate flux with either BCuP-5 or BAg-5 brazing filler metal. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside the completed joint.
9. Continuously purge the pipe and fittings during brazing with an inert gas (i.e., dry nitrogen or carbon dioxide) to prevent formation of scale. Maintain purge until the joint is cool to the touch.
10. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
11. Provide temporary cap or cover on completed joints with open ends to prevent entry of contaminating materials.

E. Mechanical Refrigerant Pipe Joints: Flared compression fittings may be used for refrigerant lines 3/4 inch and smaller.

F. Socket Joints:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Prepare surfaces to be solvent cemented by wiping with a clean cloth moistened with acetone or methylethyl keytone.
3. CPVC Joints: Solvent cement joints in accordance with ASTM D2846.
4. PVC Joints: Solvent cement joints in accordance to ASTM D2672.

G. Joints for other piping materials are specified within the respective piping system Sections.

3.05 UNIONS

A. Install unions on pipes 2 inch and smaller, adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

3.06 DIELECTRIC UNIONS

A. Install dielectric unions for piping 2 inch and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for the following conditions:
1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.

B. Install dielectric unions for piping 2 inch and smaller to connect piping materials of dissimilar metals in wet piping systems (water, steam) for the following conditions:
1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
2. Install waterway fittings where installation is concealed. Do not install dielectric unions in concealed spaces.

3.07 DIELECTRIC WATERWAY FITTINGS

A. Install dielectric waterway fittings for piping 2 inch and smaller for copper or brass pipe connections to carbon steel equipment connections.

3.08 DIELECTRIC FLANGES AND FLANGE KITS

A. Install dielectric flanges for piping 2-1/2 inch and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for the following conditions:
1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.

B. Install dielectric flanges for piping 2-1/2 inch and larger to connect piping materials of dissimilar metals in wet piping systems (water, steam) for the following conditions:
   1. Copper or brass connected to carbon steel, stainless steel, cast or ductile iron.
   2. Install waterway fittings where installation is concealed. Do not install dielectric flanges in concealed spaces.

C. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.

D. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.

E. Provide full face gasket with pressure rating equal to system served.

F. At each bolt provide steel washers, thermoplastic washers, and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.09 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

END OF SECTION 230510

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SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Support and attachment components.

B. Horizontal piping hangers and supports.

C. Saddles and shields.

D. Vertical piping clamps.

E. Pipe alignment guides.

F. Pipe anchors.

G. Pre-engineered roof pipe supports.

H. Pre-engineered roof equipment supports.

I. Anchors and fasteners.

J. Miscellaneous materials.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure

number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.

B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.

C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."

E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

F. Installer's Qualifications: Include evidence of compliance with specified requirements.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Deferred Submittals: Submit signed and sealed drawings that indicate the design and installation requirements of pre-engineered roof supports can withstand the design criteria listed in this specification. Include installation requirements for anchoring to the roof structure. The Engineer is not responsible and will not provide the seal and signature. Deliver submittal to the local AHJ for approval prior to installation of the contractor provided, pre-engineered roof supports.

1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Field-Welding:
   1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
   2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
   3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."

D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Deferred Submittals: Signed and sealed by a professional engineer or National Institute for Certification in Engineering Technologies (NICET) stamp and signature. The professional engineer shall be licensed in the same state in which the project is located.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.06 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

PART 2 PRODUCTS AND MATERIALS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test fluid. Include the weight of the pipe, valves, insulation and piping accessories.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.02 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Provide painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
      b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
      c. Natatorium or other treated pool environments: Type 316 stainless steel.
      d. Outdoor Locations: Galvanized steel or Type 304 stainless steel.

e. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
f. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
g. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
h. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
a. Cooper B-Line.
b. Ferguson Enterprises/FNW.
c. PHD Manufacturing.
d. Thomas & Betts Corporation.
e. Unistrut, a brand of Atkore International Inc.
f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-58, Type 59, MSS SP-89, and . Welds shall comply with AWS D1.1.
4. Channel Material:
a. Indoor Dry Locations: Provide carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel .
b. Indoor Damp or Wet Locations: Galvanized steel or Type 304 stainless steel.
c. Outdoor Locations: Galvanized steel or Type 304 stainless steel.
d. Natatorium or other treated pool environments: Type 316 stainless steel.
e. All nuts, brackets, and clamps shall have the same finish as the channel.
5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

C. Hanger Rods:
1. Material:
a. Indoor Dry Locations: Zinc-plated steel.
b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
c. Natatorium or other treated pool environments: Type 316 stainless steel.
2. Threaded both ends or continuously threaded.
3. Minimum Size: Reference piping specification sections for rod thicknesses.
4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12”. Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

D. Wire Rope Pipe Hanging Systems:
1. Manufacturers:

a. ASC Engineered Solutions.
b. Gripple.

2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
4. Cast-in-place Concrete Insert: Pressed steel body with sintered steel wedge, 302 stainless steel spring and UV stabilized homopolymer polypropylene end cap. Model: Gripple Spider Hanging Kit.
5. Cable Stud: Carbon steel, zinc-coated, designed for attachment to concrete inserts. Model: ASC Engineered Solutions C120.
6. Cable Coupling: Carbon steel, zinc-coated, designed for attachment to threaded rods. Model: ASC Engineered Solutions C130.
7. Cable Eyelet: Carbon steel, zinc-coated, designed to be directly attached to structural supports via anchors or fasteners. Model: ASC Engineered Solutions C150.
8. Cable Toggle: Carbon steel, zinc-coated, with toggle designed for insertion into 1/2 inch hole through steel deck hat channel and provides anchor when pulled in tension. Model: ASC Engineered Solutions C160.
9. Swivel Toggle Insert: Single assembly attached to wire rope cable, manufactured from plated carbon steel toggle, pins, and shackles; swivel insert engineered to be compatible with concrete insert.
10. Wire Rope: High tensile steel wire rope, to ASTM A1023, Class A zinc coating; minimum 7 by 7 cross-sectional thread construction; having a tensile strength of 256,000 psi; No.3 wire size minimum.
11. Adjustable Fastener: Mild steel (type UG2), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 500 lb. Model: Gripple No. 2, 3 or 4 UniGrip.

2.03 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Manufacturers:
1. Armacell.
2. ASC Engineered Solutions.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy
6. Ferguson/FNW.
7. Halfen-DEHA.
8. Hilti.
9. National Pipe Hanger Corporation.
10. PHD Manufacturing.
11. Piping Technology and Products, Inc.
12. Power-Strut.
13. Unistrut.

B. Single Hangers:
1. Band Hanger: Carbon steel, adjustable band, adjustable swivel.
2. Split Ring: Carbon steel, adjustable swivel, split ring type.
3. Clevis Hanger: Carbon steel, adjustable, clevis type.

4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

C. Trapeze and Strut-mounted Supports:
1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.

D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
a. ASC Engineered Solutions.
b. Holdrite.
c. Klo-Shure.
2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.

E. Spring Hangers:
1. Reference Section “Vibration Isolation for HVAC” for spring isolation hangers.

F. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.

G. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

H. Pre-Insulated Supports:
1. Manufacturers:
a. Aeroflex USA, Inc.
b. Armacell.
c. ASC Engineered Solutions
d. Buckaroos, Inc.
e. Cooper B-Line, Inc.
f. Pipe Shields, Inc.
2. General Construction and Requirements:
a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
c. Waterproof calcium silicate insulation shall conform to ASTM C795.
d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.

3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.04 SADDLES AND SHIELDS

A. Pipe Covering Protection Saddles:
   1. Manufacturers: Same as hanger and supports.
   2. Meet MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12 inches and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12 inches long.

B. Insulation Protection Shield:
   1. Sheet metal construction, meeting MSS SP-58 Type 40, of 18 gauge for 5-1/2 inches inside dimension and smaller, 16 gauge for 6-1/2 inches to 10-3/4 inches inside dimension, 14 gauge for 11-3/4 inches to 17 inches inside dimension, and 12 gauge for 18 inches to 28 inches inside dimension.
   2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
   3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.
   4. For pipes 2 inch and smaller without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft) 5	6	7	8	9	10
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

C. 360 Degree Insulation Protection Shield:
   1. Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

D. Plastic Saddles and Shields:
   1. Manufacturers:
      a. Armacell.
      b. Eaton.
      c. Hydra-Zorb.
      d. PHD Manufacturing.
      e. Zsi Foster.
   2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.05 VERTICAL-PIPING SUPPORTS

A. Manufacturers:
   1. ASC Engineered Solutions.
   2. Cooper B-Line, Inc.
   3. Halfen-DEHA.
   4. Hilti.
   5. ERICO/Michigan Hanger Co.
   6. National Pipe Hanger Corporation.
   7. PHD Manufacturing.
   8. Piping Technology and Products, Inc.
   9. Power-Strut.
   10. Unistrut.

B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
   2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
   3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.

C. Riser Clamps with pre-manufactured polymer insert:
   1. Manufacturers:
      a. Hydra-Zorb; Titan Riser Clamp.
      b. National Pipe Hanger.
      c. Pipe Hangers, Inc.
   2. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.06 PIPE ALIGNMENT GUIDES

A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.
   1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
   2. Pipe Diameter 10 inches and Larger: Roller type.
   3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

2.07 PIPE ANCHORS

A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.

B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

2.08 PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Manufacturers:
1. Airtec.
2. ASC Engineered Solutions.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy.
6. Ferguson/FNW.
7. Miro.
8. PHP Systems/Design.
9. PHD Manufacturing.
10. Roof Top Blox.
11. Unistrut, a brand of Atkore International Inc.
12. Zsi Foster.

B. General: Pre-engineered devices with embedded pipe support fixtures as specified.

C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
1. Up to 12 inch strut length support: 18 inch x 18 inch.
2. Up to 16 inch strut length support: 24 inch x 18 inch.
3. Up to 24 inch strut length support: 30 inch x 18 inch.
4. Thickness: Minimum 3/16 inch thick.

D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
2. Width: Nominal 4 inches.

E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.09 PRE-ENGINEERED ROOF EQUIPMENT SUPPORTS

A. Reference Section “Vibration Isolation for HVAC” for vibration isolated pre-engineered roof equipment supports.

B. Manufacturers: Subject to compliance with requirements, provide roof equipment supports from the equipment manufacturer or from one of the following:
1. AES Industries.
2. Custom Curb, Inc.
3. Pate Company.
4. Thybar.

C. Single Rail Equipment Supports:
1. Construction:
a. Base plate with fully mitered raised cant and step to match roof insulation thickness.
b. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.

c. Factory installed treated wood nailer.
d. 4 inch, minimum 18 gauge nailer jacket with counterflashing where equipment will not fully cover the equipment support.

D. Roof Curbs:
1. Construction:
a. Comply with NRCA standards.
b. Base plate with fully mitered raised cant and step to match roof insulation thickness.
c. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
d. Minimum 1-1/2 inch thick, 3 pound density rigid insulation internal to shell to maintain continuous roof insulation.
e. Factory installed treated wood nailer and drain nipple.
f. Sloped to match roof structure to enable level installation.

2.10 ANCHORS AND FASTENERS

A. Manufacturers:
1. Hilti, Inc.
2. Illinois Tool Works, Inc.
3. Phillips.
4. Powers Fasteners, Inc.
5. Rawl.
6. Simpson Strong-Tie Company Inc.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
1. Concrete: Use preset concrete inserts or expansion anchors.
2. Solid or Grout-Filled Masonry: Use expansion anchors.
3. Hollow Masonry: Use toggle bolts.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Hammer-driven anchors and fasteners are permitted only as follows:
a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.

C. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Comply with MFMA-4.
2. Channel Material: Use galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rode dimensions.
5. Manufacturers:
a. Same as manufacturer of metal channel (strut) framing system.

b. DeWalt “Bang-It” concrete inserts.

D. Post-Installed Concrete and Masonry Expansion Anchors:
1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.

E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
1. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

F. Vibration Isolation Anchors: Reference Section “Vibration Isolation for HVAC” for vibration isolation anchors.

2.11 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Malleable Iron: ASTM A47

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 ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer’s instructions.

B. Provide hangers and supports according to the Pipe Hanger and Support Schedule below.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

I. Provide vibration isolators at hangers and supports where specified in Section “Vibration Isolation for HVAC”.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.

B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

C. Space attachments within maximum piping span length specified in Division 23 piping sections.

D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

E. Install hangers, supports, clamps and attachments to support piping properly from building structure.

F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

G. Hanger and clamps sizing:
   1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
   2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
   3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
   4. Refer to Section “HVAC Insulation” for definition of hot and cold piping and required insulation thickness.

H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 23 piping sections.
   1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
   2. Where strut systems are attached to walls, install anchor bolts per manufacturer’s recommendations.
      a. Uninsulated Copper Pipe: Install with plastic galvanic isolators.
      b. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Section “HVAC Insulation”.

I. Install building attachments within concrete or to structural steel.
   1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections.

2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

K. Install appropriate types of hangers and supports to allow controlled 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. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

N. Insulated Piping: Comply with the following installation requirements.
1. Riser Clamps: Attach riser clamp to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 Section “HVAC Insulation”.
    a. Contractor’s Option: Provide riser clamps with pre-manufactured polymer insert.
2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
    a. If insulation protection shields are used instead of protection saddles on hot piping where vapor barrier is not required, provide high density insulation insert sized for the insulation thickness used as specified in Division 23 Section “HVAC Insulation”.
3. Insulation Protection Shield: Install insulation protection shield with high density insulation insert, sized for the insulation thickness used as specified in Division 23 Section “HVAC Insulation”. Do not use polymer-based shields for hot piping.
    a. Exception for 2 inch and smaller horizontal piping with cellular glass, flexible elastomeric, or polyisocyanurate insulation: High density insulation insert is not required. Provide insulation protection shield over the insulation with length specified for pipe size and insulation thickness to prevent puncture or other damage.
4. Contractor’s Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
5. Contractor’s Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer’s recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer’s recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators.

2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 23 Section "HVAC Insulation".

P. Vertical Piping Risers:
1. Reference Section "Vibration Isolation for HVAC" for piping riser supports.

Q. Wire Rope Hanging Systems:
1. Install in accordance with manufacturer's instructions.
2. Supported load shall not exceed manufacturer's recommended load rating.
3. Applications for Pipe Supports:
   a. 3 inch and smaller.
   b. Wire rope hanging system is not allowed for steam or steam condensate piping.
4. Do not support pipe by wrapping the rope around the pipe.
5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in the Pipe Hanger and Support Schedule.
6. Install cast-in-place concrete inserts in elevated concrete slabs.
7. Install bream clamps for attachment to structural beams as required.

3.04 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides at the following locations:
1. On piping that adjoins expansion joints, as required by expansion joint manufacturer. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.
2. Where roller hangers are required per Pipe Hanger and Support Schedule.
3. Elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems.

B. Install guides per ASME B31.9 unless noted otherwise.

C. Install pipe insulation at guide to not interfere with movement of pipe within the guide.

D. Anchor to building substrate.

3.05 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Spacing: 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.

3.06 INSTALLATION OF PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Install pre-engineered roof pipe supports anchored to the roof structure.
1. Install supports to meet the specified design criteria.
   a. Building Design Risk Category: II.

b. Design Wind Speed: 120 mph.

2. Coordinate with the pre-engineered roof pipe support manufacturer to anchor the pipe supports directly to the roof structure in accordance with the manufacturer's installation instructions or provide intermediate pipe supports engineered to meet the design criteria.
3. Submit design and installation requirements as a Deferred Submittal.

3.07 INSTALLATION OF ROOF EQUIPMENT SUPPORTS

A. Attach roof equipment support to the roof structure according to the manufacturer's installation instructions.

B. Provide multiple single rail equipment supports to uniformly support the equipment.

C. Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope.

D. Install supports to maintain continuous insulation on roof.

E. Provide vibration isolators between roof equipment support and equipment according to Division 23 Section "Vibration Isolation for HVAC."

F. If vibration isolation is not required or units are internally isolated, attach equipment directly to pre-engineered roof equipment support using one of the following:
   a. Hold-Down Brackets: Coordinate with the pre-engineered roof equipment support manufacturer to determine the quantity and size of hold-down brackets and fasteners, with installation instructions, for each equipment to meet the following criteria:
   b. Building Design Risk Category: II.
   c. Design Wind Speed: 120 mph.
   d. Submit design and installation requirements as a Deferred Submittal.

3.08 EQUIPMENT SUPPORT AND ATTACHMENT

A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.

C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
   1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.

F. Secure fasteners according to manufacturer's recommended torque settings.

G. Remove temporary supports.

H. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.

I. Grouting: Place grout under supports for piping and equipment.

3.09 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.10 FIELD QUALITY CONTROL

A. Examine support and attachment components for damage and defects.

B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section “Painting.”
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

F. Correct deficiencies and replace damaged or defective support and attachment components.

3.11 PIPE HANGER AND SUPPORT SCHEDULE

A. Additional hanger and support requirements are in Sections specifying piping systems and equipment.

B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:

C. Single Hangers:
   1. All pipe sizes 1-1/2 inch and less:
      a. Band hanger.
      b. Swivel split ring.
      c. Clevis hanger.
   2. Cold and Hot pipe sizes 2 inches and greater where pipes are in stationary position: Clevis hanger.
   3. Cold and Hot pipe sizes 2 inches and greater for pipes in the following locations: Roll support hanger.
      a. Axial movement due to thermal expansion or contraction generates swing angles in excess of 4 degrees.
      b. Between anchor locations shown on the drawings.

D. Trapezes and Strut-mounted Supports:
   1. Pipes in stationary position: Two-piece clamp, strut clamp or U-bolts.
   2. Cold and Hot pipe sizes 2 inches and greater in the following locations: Roll support.
      a. Axial movement due to thermal expansion or contraction generates swing angles in excess of 4 degrees.
      b. Between anchor locations shown on the drawings.

E. Wall Supports:
   1. Pipe sizes 3 inches and less:
      a. Two-hole strap mounted to wall.
      b. Welded steel bracket with reinforced angle or strut.
   2. Pipe sizes 4 inch and greater:
      a. U-bolt.
      b. Welded steel bracket with reinforced angle or strut.

F. Floor Supports:
   1. Pipes in stationary position: Pipe saddle.
   2. Cold and Hot pipe sizes 2 inches and greater in the following locations: Roll support.
      a. Axial movement due to thermal expansion or contraction is greater than one inch.
      b. Between anchor locations shown on the drawings.

END OF SECTION 230529

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SECTION 230548
SEISMIC CONTROLS FOR MECHANICAL

PART 1 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 20 Section “Seismic Controls for MEPFTR Systems” for general requirement and related documents that apply to this section.

1.03 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUMMARY

A. Seismic bracing, restraints, and controls for all mechanical systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEPFTR Systems”.

1.05 SUBMITTALS

A. Provide submittals as required by Division 20 Section “Seismic Controls for MEPFTR Systems” for all mechanical systems specified herein.

PART 2 PRODUCTS AND MATERIALS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION 230548

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Adhesive-backed duct markers.

D. Stencils.

E. Pipe markers.

F. Ceiling tacks.

G. Engraved plastic-laminate signs.

1.02 SPARE PARTS

A. Furnish minimum of 5 percent extra stock of each mechanical identification material required for each system that uses the identification material.

B. Furnish not less than 3 additional numbered valve tags for each piping system.

C. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock along with stenciling paints and applicators.

PART 2 PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Advanced Graphic Engraving, LLC.

B. Brady Corporation.

C. Brimar Industries, Inc.

D. Craftmark.

E. Industrial Safety Supply Co., Inc.

F. Kolbi Pipe Marker Co.

G. MIFAB, Inc.

H. Seton Identification Products, a Tricor Direct Company..

2.02 IDENTIFICATION APPLICATIONS AND REQUIREMENTS

A. General:
   1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, selection is the installer's option, but provide single selection for each product category.
   2. Lettering: Coordinate names, abbreviations, and other designations used in mechanical identification work with the corresponding designations shown on the drawings, scheduled, and specified. If not otherwise indicated, provide numbering, lettering, and wording as recommended by the manufacturer or as required for proper identification, operation, and maintenance of mechanical systems and equipment.
   3. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (e.g., Boiler No. 3, Air Supply No. 1H, etc.).

B. Air Handling Units: Nameplates, stencils, or engraved plastic laminate signs.

C. Air Terminal Units: Tags, stencils, or engraved plastic laminate signs.

D. Automatic Controls: Tags, use the same naming convention coordinated with the building automation system.

E. Control Panels: Nameplates.

F. Dampers: Ceiling tacks where located above lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.

G. Ductwork: Adhesive-backed duct markers. Stencils are only acceptable for concealed ductwork, exterior ductwork, or in mechanical rooms.

H. Fans: Nameplates, stencils, or engraved plastic laminate signs.

I. Heat Transfer Equipment: Nameplates, stencils, or engraved plastic laminate signs.

J. Humidifiers: Nameplates or engraved plastic laminate signs.

K. Instrumentation: Tags.

L. Major Control Components including Variable Frequency Drives: Nameplates or engraved plastic laminate signs.

M. Piping: Pipe Markers.

N. Pumps: Nameplates or engraved plastic laminate signs.

O. Relays: Tags.

P. Small-sized Equipment: Tags.

Q. Tanks: Nameplates or engraved plastic laminate signs.

R. Thermostats: Nameplates.

S. Valves: Tags. Ceiling tacks are acceptable where located above a lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.

T. Water Treatment Devices: Nameplates or engraved plastic laminate signs.

U. General Signs: Engraved plastic laminate signs.

2.03 NAMEPLATES

A. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
1. Name and mark number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

B. Size: 2-1/2 inch x 4 inch for control panels and components, 4-1/2 inch x 6 inch for equipment.

C. Letter Color: White.

D. Letter Height: 1/4 inch.

E. Background Color:
1. Cooling equipment: Green.
2. Heating equipment: Yellow.
3. Combination cooling and heating equipment: Yellow/Green.
4. Energy reclamation equipment: Brown.
5. Hazardous equipment: Colors and designs recommended by ASME.
6. Equipment and components that do not meet any of the above criteria: Blue.

F. Plastic: Conform to ASTM D709.

2.04 TAGS

A. Plastic Laminate Tags: Laminated three-layer plastic, minimum 3/32 inch thick, with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.

B. Solid Plastic Tags: Solid plastic, minimum 3/32 inch thick, with printed black letters on white color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.

C. Metal Tags: Provide 19-gauge polished brass with stamped letters. Tag size minimum 1-1/2 inch diameter with smooth edges and 5/32 inch hole for fastener. Fill tag engraving with black enamel paint.

D. Accident Prevention Tags: Pre-printed or partially pre-printed, of plasticized card stock with matte finish suitable for writing, minimum 3-1/4 inch x 5-5/8 inch size, with brass grommet in hole for fastener. Order with appropriate pre-printed wording (e.g., DANGER, CAUTION, DO NOT OPERATE, etc.).

E. Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks of the size required for proper attachment of tags to valves, manufactured specifically for that purpose.

F. Valve Tag Chart: Typewritten letter size list in anodized aluminum or finished hardwood frame, covered with SSB-grade sheet glass. Provide frame and mounting screws for removable mounting.

G. Letter Height:
1. System Abbreviation: Minimum 1/4 inch.
2. Valve Number: Minimum 1/2 inch.

2.05 ADHESIVE-BACKED DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

B. Style: Individual label.

C. Nomenclature: Include air handling unit identification number, duct size, service, and arrows indicating direction of flow.

D. Specialty Exhaust: Identify the specialty using the system terminology (e.g., Grease, Dishwasher, Dryer, Fume Hood, etc.).

E. Color: Yellow background with black lettering or blue background with white lettering.
1. Hazardous Exhaust: Use colors and designs recommended by ASME A13.1.

2.06 STENCILS

A. Stencils: With clean cut symbols and letters of following size, complying with ASME A13.1:
1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
6. Ductwork and Equipment: 2-1/2 inch high letters.
7. Access Doors: 3/4 inch high letters.
8. Operational Instructions: 3/4 inch high letters.
9. Provide arrows indicating direction of flow.

B. Stencil Paint: Oil based, alkyd enamel, either brushing grade or pressurized spray-can form and grade, black color, except for piping. For piping systems use colors conforming to ASME A13.1.

2.07 PIPE MARKERS

A. Semi-rigid Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings, minimum 3 mil thick.
   1. Width: 1-1/2 inch for pipes less than 6 inches (including insulation), 2-1/2 inch for pipes 6 inches and larger (including insulation).

C. Pipe Marker with Insulation: 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F or greater. Insulation shall extend 2 inches beyond each end of plastic pipe marker.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
   1. Detection: Provide multi-ply tape consisting of solid aluminum foil core between two layers of plastic ribbon tape.

E. Nomenclature: Manufacturer's standard pre-printed nomenclature which best describes piping system. Differentiate between supply and return. In the case of a variance, provide nomenclature as selected by the Engineer.

F. Arrows: Provide pipe markers with integral arrows indicating direction of flow or as a separate unit of plastic.

G. Color:
   1. Conform to .
   2. Heating, Cooling, and Boiler Feedwater: Green with white letters.
   3. Toxic and Corrosive Fluids: Orange with black letters.
   4. Compressed Air: Blue with white letters.

H. Letter Height: Minimum 1/2 inch for pipes up to 3 inch, minimum 1 inch for larger pipes.

2.08 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

2.09 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Engraving stock melamine plastic laminate, engraved with manufacturer’s standard letter style, black with white core letter color except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16 inch thick for units up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

D. Nomenclature: When used to identify equipment, match terminology on schedules, including the following:

1. Name and mark number.
2. Equipment service.
3. Design capacity.

E. Access Panel Markers: Laminated three-layer plastic, minimum 1/16 inch thick and 1/8 inch hole for fastener, with abbreviations and numbers corresponding to concealed valve.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 GENERAL INSTALLATION

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Install products in accordance with manufacturer’s instructions.

C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

D. Install tags on piping 3/4 inch diameter and smaller.

E. Install in clear view and align with axis of piping.

F. Apply stencil painting in accordance with Division 09.

G. Identify service, flow direction, and pressure.

3.03 PIPING IDENTIFICATION

A. General: Install identification on the most obviously visible portion of the pipe from the point of access.

B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

C. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe during back-filling/top-soiling of each underground piping system, Where multiple pipes are buried in common trench and do not exceed overall width of 16 inches, install single pipe marker. For tile fields and similar artificial field installations, mark only edge pipe lines of field.

D. Pipes less than 6 inches diameter (including insulation):, Provide full-band pipe markers with 360 degree coverage.

E. Pipes 6 inches diameter and larger (including insulation): Provide either full-band or strip-type pipe markers.

F. Location: Install piping identification where piping is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc.) and exterior non-concealed locations as follows:
   1. Within 5 feet of each valve, tee, and control device.
   2. Within 5 feet of each branch, excluding branches less than 25 feet in length to fixtures or terminal heating and cooling units.
   3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.
   4. At access doors, manholes and similar access points which permit view of concealed piping.
   5. Within 5 feet of equipment outlets and other points of origination and termination.
   6. Spaced intermediately at a maximum spacing of 50 feet along each riser and run. Reduce spacing to 25 feet in congested areas where there are more than two piping systems or pieces of equipment.

G. Identify refrigerant piping located in areas other than the room or space where the refrigerant equipment is located in accordance with ANSI/ASME A13.1.
   1. Indicate the refrigerant designation and safety group classification of refrigerant used in the piping system.
   2. For Group A2L refrigerant piping include the following statement: “WARNING – Risk of Fire, Flammable Refrigerant”.

3.04 VALVE IDENTIFICATION

A. Provide a tag on each valve, cock, and control device. Exclude check valves, valves within factory-fabricated equipment, HVAC terminal devices, and similar rough-in connections of end-use fixtures and units.

B. Mount valve tag chart and schedule frame in mechanical room, or where indicated on plans. If not indicated, mount where directed by Engineer. Where more than one mechanical room is included on the project, mount framed copies of valve tag chart and schedule in each mechanical room.

3.05 DUCTWORK IDENTIFICATION

A. Install identification on the most obviously visible portion of the duct from the point of access.

B. Location: Install ductwork identification where ductwork is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc), and exterior non-concealed locations as follows:
   1. Within 5 feet of each control damper or balancing damper, excluding balancing dampers installed in duct take-offs to individual grilles, registers, or diffusers that are less than 25 feet in lengths and installed in the same space as the air device.
   2. Within 5 feet of each branch duct, excluding branch ducts that are less than 25 feet in length and located in the same space as the main duct.
   3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.

4. Spaced intermittently at a maximum spacing of 50 feet along each duct run. Reduce spacing to 25 feet in congested areas when there are more than two types of duct systems or pieces of equipment.
5. Within 5 feet of equipment outlets and other points of origin or termination.
6. Install marker on the most obviously visible portion of the duct from point of access.

3.06 ACCESS DOOR IDENTIFICATION

A. Provide identification on each access door, indicating purpose of access, maintenance and operating instructions, and appropriate safety and procedural information.

B. Where access doors are concealed above a removeable ceiling system or similar concealment, tags may be used in lieu of specified identification.

3.07 CEILING TACK INSTALLATION

A. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.08 EQUIPMENT IDENTIFICATION

A. Install nameplates and engraved plastic laminate signs for identification of equipment. Provide additional signs and lettering as follows:
   1. To distinguish between multiple units in close proximity.
   2. To inform operator of operational requirements.
   3. To indicate safety and emergency precautions.
   4. To warn of hazards and improper operations.

B. Adjust lettering size based on viewing distance from normal location of identification:
   1. Less than 2 feet: Minimum 1/4 inch.
   2. Up to 6 feet: Minimum 1/2 inch.
   3. Greater than 6 feet: Proportionally increase letter size based on recommendations above.
   4. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
   5. Stencils may be used in lieu of nameplates when lettering greater than 1 inch is needed for proper identification because of distance from normal location of required identification.

C. Where equipment to be identified is concealed above acoustical ceilings or similar removeable concealment, equipment tags may be installed in the concealed space to reduce the amount of text in exposed sign.

END OF SECTION 230553

SECTION 230593
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. General testing, adjustment, and balancing requirements.

B. Testing, adjustment, and balancing of air systems.

C. Sound and vibration measurement of equipment operating conditions.

D. This section excludes:
1. Testing boilers and pressure vessels for compliance with safety codes;
2. Specifications for materials for patching mechanical systems;
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
4. Requirements and procedures for piping and ductwork systems leakage tests.

1.02 DEFINITIONS

A. TAB: Testing, adjusting, and balancing.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the major or entire fluid flow of the system.

I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.

J. Branch main: Duct or pipe serving two or more terminals.

K. Branch: Duct or pipe serving a single terminal.

1.03 SUBMITTALS

A. Qualifications:
   1. Submit qualifications of TAB agency.
   2. Submit qualifications of TAB supervisor.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

C. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Progress Reports.

F. Certified TAB Reports:
   1. General:
      a. Submit within two weeks after completion of testing, adjusting, and balancing.
      b. Revise TAB plan to reflect actual procedures and submit as part of final report.
      c. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   2. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
   3. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:
      a. The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
      b. The report reflects an accurate representation of how the systems have been installed.
      c. The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
      d. The report is an accurate record of all final quantities measured to establish normal operating values of the systems.
   4. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:
      a. General Information and Summary
         1) Include project name, location, altitude, and date.
         2) Identify TAB agency, contractor, owner, architect, and engineer.
         3) Include addresses, contact names, and telephone numbers.

4) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
5) Include actual instrument list, with manufacturer name, serial number, and date of calibration.

b. Air Systems
c. Temperature Control Systems
d. Special Systems
e. Sound and Vibration Systems

5. Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.

G. Project Record Documents: Provide drawings that record actual locations of flow measuring stations and balancing devices.

1.04 QUALITY ASSURANCE

A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter “Testing, Adjusting, and Balancing”, most current edition.

C. TAB Agency Qualifications:
1. Act as the single source of responsibility for TAB of the HVAC systems.
2. Staff the project at all times by qualified personnel.
3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
4. Certified by one of the following Certification Associations:
a. AABC (NSTSB): Associated Air Balance Council, National Standards for Total System Balance.
b. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
c. TABB: Testing, Adjusting, and Balancing Bureau, SMACNA TAB Procedural Guide.

D. TAB Supervisor and Technician Qualifications:
1. Certified by the same organization as TAB agency.
2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.

PART 2 PRODUCTS AND MATERIALS – NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.

B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

C. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.

D. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

E. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.

F. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.

G. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

H. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Motors and bearings are lubricated.
   5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   6. Duct systems are clean of debris.
   7. Fans are rotating correctly and belts have tension.
   8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
   9. Air coil fins are cleaned and combed.
   10. Volume dampers are installed at locations needed for balancing the air systems.
   11. Access doors are closed and duct end caps are in place.
   12. Air outlets are installed and connected.
   13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.

B. Furnish all instruments required for testing, adjusting, and balancing operations.
1. Verify all instruments have been calibrated.
2. Furnish instruments as recommended by the manufacturer for the TAB application.
3. Furnish instruments that are best suited to the function being measured.
4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.

D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.

E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

F. Determine best locations in main and branch ductwork for most accurate duct traverses.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.

B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.

C. Hydronic Systems: Balance to within plus or minus 5 percent of design flow.

3.05 RECORDING AND ADJUSTING

A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.

B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:

1. Dry bulb temperature.
2. Relative humidity.
3. Cloud cover.
4. Wind speed.
5. Time.

C. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

D. Ensure recorded data represents actual measured or observed conditions.

E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.

J. Seal ducts and piping and test and repair leaks.

K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

M. Check and adjust systems approximately six months after final acceptance and submit report.

N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.

O. Take all readings at eye level of the indicated value to prevent parallax.

P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

Q. Take measurements in the system where best suited for the task.

R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.06 AIR SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

A. Check filters for cleanliness.

B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

C. Verify volume dampers are installed at locations needed for balancing the air systems.

D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

E. Determine best locations in main and branch ductwork for most accurate duct traverses.

F. Place outlet dampers in the full open position.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

H. Lubricate all motors and bearings.

I. Check fan belt tension.

J. Check fan rotation.

K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.

L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

M. Measure air quantities at air inlets and outlets.

N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.

P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

U. Where modulating dampers are provided, take measurements and balance at design conditions. Balance variable volume systems at design air flow rate and at minimum air flow rate.

V. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship to maintain building pressure setpoint.

W. Multi-Zone units with Mixing Dampers: Check for motorized damper leakage. Adjust air quantities with mixing dampers set first at design cooling, then at design heating.

X. For variable air volume boxes, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

Y. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 TESTING FOR SOUND AND VIBRATION

A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards:
   1. ASHRAE: ASHRAE Handbook, HVAC Applications Volume, Chapter “Sound and Vibration Control”, most current edition.

B. Other than sound data, failure of an item includes a deviation of more than 10 percent from setpoint. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
   1. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

C. Prepare and submit report of recommendations for correcting any sound or vibration levels that are outside of manufacturer’s tolerances, ASHRAE standards and/or values specified in the contract documents.

END OF SECTION 230593

SECTION 230700
HVAC INSULATION

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Piping Insulation.

B. External Ductwork Insulation.

C. Equipment Insulation.

1.02 RELATED REQUIREMENTS

A. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, pipe saddles, and high-density insulation inserts.

B. Division 23 Section “Buried Hydronic Piping,” for insulation of piping installed below grade.

C. Division 23 Section “Metal Ducts” for duct liner insulation.

1.03 DEFINITIONS

A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.

B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.

C. Low Pressure Steam Systems: 15 psig and less.

D. High Pressure Steam Systems: Greater than 15 psig.

E. Cold Duct: Ductwork that carries airflow with a minimum operating temperature less than 65 degrees F temperature.

F. Hot Duct: Ductwork that carries airflow with a minimum operating temperature greater than 75 degrees F temperature.

G. Neutral Ductwork: Ductwork that carries airflow with temperatures between the defined cold and hot temperatures.

H. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.

I. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.

J. Exposed: Insulation that is visible from the occupied space.

K. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.

L. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.

M. Unconditioned Spaces: An enclosed space within a building that is not provided with mechanical heating or cooling.

1.04 SUBMITTALS

A. Product Data: Submit technical product data, thermal characteristics, and materials for each type of mechanical insulation.

B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

B. 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.

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 UL 723 or ASTM E84 (NFPA 255) method.
   1. Exception: Exterior mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
   2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
   3. Exception: Polyisocyanurate insulation that is not installed in a return air plenum may have a flame spread index of 25 and smoke developed index of 450.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS AND MATERIALS

2.01 PIPING INSULATION MATERIALS

A. Cellular Glass:
   1. Manufacturers:
      a. Owens Corning.
   2. Insulation: ASTM C552, Type II, Grade 6, rigid closed glass cells pre-formed for the application.
      a. K-value: ASTM C518 or C177, maximum 0.34 at 75 degrees F.
      b. Minimum Service Temperature: Minus 450 degrees F.
      c. Maximum Service Temperature: 800 degrees F.
      d. Density: Minimum 6.12 pounds per cubic feet.

B. Flexible Elastomeric:
   1. Manufacturers:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. K-Flex USA.
   2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
      a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
      b. Minimum Service Temperature: Minus 297 degrees F
      c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
   3. Factory Applied Jacket:
      a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Piping Jacket Schedule in Part 3 of this specification for application of this jacket.

C. Field-Applied Jacket:
   1. Canvas: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   2. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
      a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
      b. Manufacturers:
         1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
         2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
         3) Or approved equal.

3. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:

Outer Insulation Diameter (in)	Minimum Aluminum Jacket Thickness, (in) Non-Rigid Insulation	Rigid Insulation	Finish
≤ 8	0.016	0.016	Stucco
< 12	0.020	0.016	Stucco
≤ 24	0.024	0.016	Stucco
≤ 36	0.032	0.020	See Note 1
> 36	0.040	0.024	See Note 1

Note 1: Use corrugated finish for non-rigid insulation. Use stucco finish for rigid insulation.

a. Banding:
   1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
   2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.

4. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
5. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulated duct and piping applications. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 15 pounds per ASTM D1000.

D. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05

Pipe and vessels (-40 F to 32 F)	0.02	0.02
Ducts (40 F to ambient)	1.0	0.03

Notes:
1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.
2. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.

F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

H. High Density Insulation Billets:
1. Calcium Silicate: ASTM C533 and C795.
2. Flexible elastomeric: ASTM C534, Type 1.
3. Polystyrene: ASTM C578, Type XIII.
4. Phenolic: ASTM C1126, Type III, Grade 1.

2.02 EXTERNAL DUCTWORK INSULATION MATERIALS

A. Flexible Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
   a. CertainTeed Corp.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
2. Insulation: ASTM C553, Type I or II, flexible mineral fiber blanket.
   a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
   b. Minimum Service Temperature: Minus 20 degrees F
   c. Maximum Service Temperature: 450 degrees.
   d. Density:
      1) 0.75 pounds per cubic foot.
      2) 1.5 pounds per cubic foot.
3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
   a. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms and 2 inch stapling tab.
   b. Polypropylene Scrim Kraft (PSK): Kraft paper with glass fiber yarn and bonded to metalized polypropylene, water vapor permeance of 0.02 perms and 2 inch stapling tab.
   c. Color: White.

B. Rigid Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
   a. Johns Manville.
   b. Knauf Insulation.
   c. Owens Corning.
2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.

a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
b. Minimum Service Temperature: 0 degrees F
c. Maximum Service Temperature: 450 degrees.
d. Density:
1) 1.5 pounds per cubic foot.
2) 3.0 pounds per cubic foot.

3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
b. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms.
c. Polypropylene Scrim Polyester (PSP): Polyester paper with glass fiber yarn and bonded to polypropylene, water vapor permeance of 0.02 perms.
d. Color: White.

C. Field-Applied Jacket:
1. Canvas: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
2. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
a. Thickness: 0.032 inch sheet.
b. Finish: Smooth or Stucco. Reference Part 3 for jacket applications.
c. Joining: Longitudinal slip joints and 2 inch laps.
d. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
3. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
a. Water Vapor Transmission: 0.0 perms per ASTM E96.
b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
4. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulation. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, pins with insulation retaining washers, anchors, corner angles and other appurtenances as recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coatings, sealers, mastics, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.
1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
2. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
3. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Fosters 30-80, Childers CP-38, Design Polymerics 3040, or equal.

4. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
5. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 EQUIPMENT INSULATION MATERIALS

A. Flexible Mineral Fiber (rock, slag, or glass):
   1. Manufacturers:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
   2. Insulation: ASTM C553, Type I and II or ASTM C547 Type II, flexible mineral fiber blanket.
      a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
      b. Minimum Service Temperature: Minus 20 degrees F
      c. Maximum Service Temperature: 450 degrees F for ASTM C553 Types I and II, 1200 degrees F for ASTM C547 Type II.
      d. Density: Minimum 1.5 pounds per cubic foot.
   3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
      a. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms and 2 inch lap.
      b. Color: White.

B. Calcium Silicate:
   1. Manufacturers:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
   2. Insulation: ASTM C533, Type I, rigid molded, asbestos free, pre-formed for the application.
      a. K-value: ASTM C335 or C518, maximum 0.45 at 200 degrees F.
      b. Minimum Service Temperature: 80 degrees F
      c. Maximum Service Temperature: 1200 degrees F.
      d. Density: Maximum 15 pounds per cubic feet.

C. Field-Applied Jacket:
   1. Canvas: UL listed, minimum 8 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   2. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
      a. Thickness: 0.032 inch sheet.
      b. Finish: Smooth.
      c. Joining: Longitudinal slip joints and 2 inch laps.
      d. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
   3. Stainless Steel: ASTM A666, Type 304 stainless steel.
      a. Thickness: 0.010 inch sheet.

b. Finish: Smooth.
c. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

4. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
   a. Water Vapor Transmission: 0.0 perms per ASTM E96.
   b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
5. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulation. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.

D. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, and other appurtenances as recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coating, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
2. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Foster 30-80, Childers CP-38, Design Polymerics 3040, or equal.
3. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36. Childers CP-50AHV2 or equal.
4. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 PROTECTION AND REPLACEMENT

A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.

B. Repair existing mechanical insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.

C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.03 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

3.04 PIPING SYSTEM INSULATION INSTALLATION

A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Exposed Piping: Locate insulation and cover seams in least visible locations.

E. Cold Pipe Insulation:
   1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
   2. Provide vapor barrier jacket according to the Piping Jacket Schedule.
   3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section “Hangers & Supports for HVAC Piping & Equipment” for pre-insulated supports and insulation shields. and for exception where high density insulation inserts are not required.
   4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
   5. Secure all-service jacket with self-sealing longitudinal laps.
   6. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

F. Hot Pipe Insulation:
   1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
   2. Provide jackets without vapor barrier according to the Piping Jacket Schedule. Jackets with vapor barrier are allowed.
   3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section “Hangers & Supports for HVAC Piping & Equipment” for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.
   4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
   5. Secure all-service jacket with self-sealing longitudinal laps.
   6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.

G. Insulation of Fittings, Valves, Strainers, Flanges, and Unions:
   1. Insulate fittings, joints, and valves with molded insulation of like material, vapor barrier coating, and thickness as adjacent pipe. Provide pre-formed insulation pieces, segmented insulation, or sectional pipe insulation for the application. Provide the same insulation jacket as adjoining pipe.
   2. Sectional pipe insulation: Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Hold sectional cuts in place with tie wire or bands. Wire and bands shall be compatible with insulation and jacket.
   3. Segmented pipe insulation: Cover segmented insulated surfaces with a layer of finishing cement and finish with a coating or mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the coating or mastic to a smooth and well-shaped contour.
   4. Butt each insulation piece tightly against adjoining piece of insulation. Bond pieces together according to Cold Pipe or Hot Pipe installation instructions.
   5. Insulate valves up to and including the bonnets, valve stuffing-box studs, bolts, and nuts with a removeable insulation cover. Sectional valve insulation covers shall divide the section along the vertical center line of the valve body.
   6. 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.
   7. Insulate flanges and unions with a removeable insulation cover. Sectional pipe insulation covers shall divide the section along the center line of pipe.
   8. When removeable covers are made from sectional block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, around the insulated device with tie wire. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
   9. 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. PVC fitting covers with end caps are also acceptable. Tape PVC covers to adjoining insulation facing using PVC tape.
   10. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

H. 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.

I. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated. Maintain vapor barrier through the penetration.

J. Exterior Piping and Piping Exposed to Weather:
   1. General: Provide piping jacket around insulation as scheduled in the Piping Jacket Schedule. Jacket material shall be approved by the jacket manufacturer for use with the specific insulation material that it covers. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.
   2. Paintable Coating: After adhesive has fully cured, apply two coats of insulation manufacturer’s recommended protective coating.

3. Polymeric Coating: Provide insulation shields so that the piping supports do not puncture, cut or break the jacket.
4. Rigid aluminum shell: Space attachment bands 12 inches on center and directly centered over end joints.
5. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
6. Rubberized Asphalt Vapor Barrier Cladding: Install cladding for use in ambient temperatures as low as minus 10 degrees F.

3.05 PIPING SYSTEM INSULATION SCHEDULE

A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.

B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.

C. Omit insulation on the following:
1. Hot piping within radiation enclosures or unit cabinets.
2. Cold piping within unit cabinets provided piping is located over drain pan.
3. Heating piping between coil and shutoff valves provided piping is located within heated space and not more than three feet from coil.
4. Condensate piping between steam trap and union.
5. Steam relief vent piping.
6. Chiller emergency refrigerant vent piping.
7. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.

D. Exterior Piping: Insulate all exterior HVAC piping with one of the following:
1. Flexible elastomeric, use high temperature formula for systems with operating temperatures above 220 F. (not acceptable for steam, steam condensate or hot water piping systems with temperatures above 300 F).

E. Sub-Freezing Piping (0 to 39 degrees F (-18 to 4 degrees C)):
1. Service:
a. Refrigerant liquid lines between the expansion valve and the evaporator coil.
b. Refrigerant suction lines between evaporator coil and compressor.
2. Acceptable Insulation:
a. Flexible elastomeric.

F. Warm Temperature Piping (105 degrees to 140 degrees F (40 to 94 degrees C)):
1. Service:
a. Refrigerant liquid lines between the condensing unit and expansion valve.
2. Insulate each piping system specified above with one of the following types of insulation.
a. Flexible elastomeric.

3.06 PIPE INSULATION THICKNESS SCHEDULE

A. ASHRAE 90.1 – 2019 Requirements, Pipe Insulation

Minimum Pipe Insulation Thickness

Fluid Operating Temp. Range (°F) And Usage	Insulation Conductivity Conductivity, Btu·in./(hr·ft²·°F)	Mean Rating Temp., °F.	Nominal Pipe or Tube Size (in.) <1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness, in.				
>350°F	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251°F–350°F	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201°F–250°F	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.22–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
<40°F	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

Notes:

a. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: T = r{(1 + t/r)^(K/k) – 1} where
   1) T = minimum insulation thickness (in.),
   2) r = actual outside radius of pipe (in.),
   3) t = insulation thickness listed in this table for applicable fluid temperature and pipe size,
   4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./hr·ft²·°F); and
   5) k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.

c. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote a) but not to a thickness less than 1 inch.

d. For piping that shall be installed below grade, reference Division 23 section "Underground Hydronic and Steam Piping."

e. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

3.07 PIPING JACKET SCHEDULE

A. Exposed piping:
   1. All-service jacket.
   2. Canvas.
   3. Semi-rigid PVC.

B. Exterior piping, piping exposed to weather and piping in unconditioned spaces:

1. Paintable coating (flexible elastomeric insulation only.)
2. Polymeric Coating (flexible elastomeric insulation only).
3. Semi-rigid PVC for outdoor application(flexible elastomeric insulation on refrigerant piping only).
4. Rigid aluminum shell.
5. Multilayer laminate vapor barrier cladding.
6. Rubberized asphalt vapor barrier cladding.

3.08 DUCTWORK INSULATION SYSTEM INSTALLATION

A. Maintain continuous thermal and vapor-barrier integrity throughout entire installation and protect it from puncture and other damage.

B. Install insulation on duct systems subsequent to painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces.

D. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Install insulation without sag on underside of duct. Where rectangular ducts are 24 inches in width or greater, secure external insulation to the bottom of the duct with mechanical fasteners, spaced on 18 inches on center (maximum). Fasteners shall include 2-inch square self-sticking galvanized carbon-steel base plates with minimum 0.106-inch diameter zinc-coated, low carbon steel, fully annealed shank spindle, length to suit depth of insulation. Secure insulation to spindles with self-locking washers incorporating a spring steel insert to ensure permanent cap retention. Lift duct off trapeze hangers and insert spacers to avoid insulation compression.

F. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

H. Lined Ductwork: At interface of lined and wrapped ductwork, overlap lined ductwork by 2 feet (minimum) with wrapped insulation.

I. Cold Ducts:
   1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
   2. Provide vapor barrier jacket according to the Ductwork Jacket Schedule.
   3. Seal joints with vapor barrier mastic.
   4. Continue insulation, including vapor barrier, through walls, sleeves, hangers, and other duct penetrations.
   5. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   6. Where cold ducts are installed in mechanical rooms or non-conditioned spaces (excludes return air plenums), prevent condensation from forming on the duct supports by providing one or more of the following:
      a. Install thermal break such as rigid board insulation between the support and duct.

b. Wrap support that is in contact with the duct with external duct wrap insulation to prevent condensation. Wrap shall extend a minimum of 12 inches from point of contact of the support with the duct. Tape joints to provide a thermal and vapor barrier. Coat all taped joints, punctures and seams with 4 inch wide coating of vapor barrier mastic.
c. If a support device similar to Unistrut is used, foam fill or stuff tube.

J. Hot and Neutral Ducts:
1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
2. Provide jackets with or without vapor barrier according to the Ductwork Jacket Schedule.
3. Secure joints with staples, tape, or wires.
4. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.09 DUCTWORK SYSTEM INSULATION SCHEDULE

A. Omit insulation on the following:
1. Fibrous glass ductwork (ductboard).
2. Lined ductwork that is interior to the building unless otherwise indicated on the drawings.
3. Interior ductwork with sound absorbing linings unless otherwise indicated on the drawings.

B. Prohibited insulation:
1. Polyisocyanurate installed within a return air plenum.

C. Outdoor Air:
1. Service:
a. Interior untreated outdoor air intake ducts.
b. Pre-conditioned outdoor air ducts.
c. Combustion air intake ducts.
2. Acceptable Insulation:
a. Flexible mineral fiber.
b. Rigid mineral fiber.

D. Supply Air:
1. Service:
a. Supply ducts from air handling equipment.
b. Insulate neck and bells of supply diffusers.
2. Acceptable Insulation:
a. Flexible mineral fiber.
b. Rigid mineral fiber.

E. Return Air:
1. Service:
a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
b. Interior ductwork routed through or from unconditioned spaces and plenums.
2. Acceptable Insulation:
a. Flexible mineral fiber.
b. Rigid mineral fiber.

F. Exhaust Air.
1. Service:
a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
b. Interior ductwork routed through conditioned spaces (excludes ductwork routed in shafts) that is exhausting from unconditioned spaces (such as loading docks, garages, etc.).
c. Interior ductwork downstream of heat recovery device (wheel, plate, heat pipe, etc.) to exterior discharge outlet.
d. Exterior ductwork upstream of heat recovery device (wheel, plate, heat pipe, etc.).
e. Range and kitchen hood non-grease exhaust ductwork.
2. Acceptable Insulation:
a. Flexible mineral fiber.
b. Rigid mineral fiber.

G. Range and hood grease exhaust ductwork: Refer to Section "Air Duct Accessories" for requirements of fire-rated wrap insulation for grease exhaust duct.

3.10 DUCT SYSTEM INSULATION THICKNESS SCHEDULE

A. Flexible Mineral Fiber:
1. Interior Ductwork:
a. 0.75 pounds per cubic foot density:
1) 1-1/2 inch thick, minimum R-4.2.
b. 1.5 pounds per cubic foot density:
1) 1-1/2 inch thick, minimum R-4.2.
2. Meet R-value installed at maximum 25% compression, application limited to concealed locations.

B. Rigid Mineral Fiber:
1. Interior Ductwork:
a. 1.5 pounds per cubic foot density:
1) 1 inch thick, minimum R-4.2.
b. 3 pounds per cubic foot density:
1) 1 inch thick, minimum R-4.2.
c. 6 pounds per cubic foot density:
1) 1 inch thick, minimum R-4.2.
2. Ductwork installed in machine, fan, and mechanical equipment rooms:
a. 2 inch thick, minimum R-8.0.
3. Ductwork in an Unconditioned Space:
a. 1-1/2 inch thick, minimum R-6.0.

3.11 EQUIPMENT INSULATION INSTALLATION

A. Install insulation subsequent to painting, testing, and acceptance of tests.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Protect insulation to prevent puncture and other damage.

D. Exposed Equipment: Locate insulation and cover seams in least visible locations.

E. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

F. Do not apply insulation to equipment, breechings, or stacks while hot.

G. Do not insulate flanges and unions of equipment carrying fluids less than 105 degrees F.

H. Provide neatly beveled edge at interruptions of insulation.

I. Fasten insulation to equipment with studs, pins, clips, adhesives, wires, or bands.

J. Stagger insulation joints for both single and double layer application, where feasible. Apply each layer of insulation separately. Tape all joints using glass cloth or a suitable, matching acrylic adhesive tape; minimum 3 inches wide.

K. Coat insulated surfaces of calcium silicate with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

L. Cover insulated surfaces with jacketing, factory or field applied, neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable. Tape all joints using glass cloth or a suitable, matching acrylic adhesive tape; minimum 3 inches wide.

3.12 EQUIPMENT INSULATION SCHEDULE

A. Omit Insulation on the following:
   1. Boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplates.
   2. Factory pre-insulated equipment.

B. Do not apply insulation to equipment that operates outside of the minimum and maximum service temperature range.

C. Provide flexible removable and reusable blanket insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

D. Breechings, Chimneys, and Stacks:
   1. Service:
      a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.
      b. Stack from bottom to top except for factory insulated stacks.
   2. Acceptable Insulation:
      a. Flexible Mineral Fiber: 2 inch thick.
      b. Calcium Silicate: 2 inch thick.

3.13 EQUIPMENT JACKET SCHEDULE

A. Omit jacketing on equipment pre-insulated and jacketed from the factory.

B. Interior Equipment (all except flexible elastomeric insulation):
   1. Canvas.
   2. Aluminum.
   3. Stainless steel.

END OF SECTION 230700

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SECTION 230800
COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Commissioning process requirements for HVAC systems, assemblies, and equipment.

1.02 SUMMARY

A. Commissioning Authority
   1. Retain the services of a third-party registered design professional or approved agency that is regularly engaged in conducting commissioning to perform the duties of the Commissioning Authority including development of the commissioning plan, supporting documentation, and reports.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned shall be responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CxA) shall direct and coordinate all commissioning activities and provide Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The entire HVAC system and its appurtenances shall be commissioned, including controls, ductwork, piping, noise and vibration control devices, specialty systems (e.g., smoke control systems), and other systems identified elsewhere in the Contract Documents.

E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.03 RELATED REQUIREMENTS

A. Division 01 Commissioning requirements that apply to all types of work.

1.04 REFERENCE STANDARDS

A. ASHRAE Guideline 0 – The Commissioning Process, most current edition.

B. - The HVAC Commissioning Process; most current edition.

1.05 DEFINITIONS

A. Refer to Division 01 “General Commissioning Requirements” for additional abbreviations and definitions.

B. BAS: Building Automation System.

C. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. Commissioning Authority (CxA): An entity who coordinates the commissioning team to implement the Commissioning Process.

E. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.

F. Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the OPR. Commissioning is intended to achieve the following objectives:
   1. Verify that applicable systems and equipment are designed and installed according to the manufacturer's recommendations and to industry accepted minimum standards.
   2. Verify that applicable systems and equipment receive adequate operational checkout by installing contractors.
   3. Verify and document proper performance of equipment and systems.
   4. Verify that O&M documentation provided to the Owner is complete.
   5. Verify that the Owner's operating personnel are adequately trained.

G. Commissioning Report: A report that includes the following:
   1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
   2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
   3. Itemization of resolved deficiencies found during preliminary commissioning.
   4. List of deferred tests that cannot be performed at the time of final commissioning report preparation because of climatic conditions.

H. Functional Performance Test (FPT): A test that verifies the equipment or item being tested performs in the manner intended.

I. Owner's Project Requirements (OPR). A document that details the functional requirements of a project and the expectations of how it will be used and operated, including the following:
   1. Project goals.
   2. Energy efficiency goals.
   3. Ventilation requirements.
   4. Project documentation requirements
   5. Facility functions.
   6. Hours of operation and any need for after-hours operation.
   7. Equipment and system expectations.
   8. Building envelope performance expectations.
   9. Measurable performance criteria.
   10. Cost considerations.
   11. Benchmarks.
   12. Success criteria
   13. Supporting information.

J. Operations and Maintenance Manual (O&M): A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner during the occupancy and operation of the building.

K. Pre-Functional Checklist (PFC): A checklist that verifies all components and accessories related to a system that will be subjected to an FPT are present and functional.

L. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

M. TAB: Testing, Adjusting, and Balancing.

1.06 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to the HVAC system documentation made during installation, and startup; revise and resubmit when substantial changes are made.

B. Submit a commissioning plan that includes the following:
   1. General project information and commissioning goals.
   2. Commissioning team information.
   3. Narrative description of commissioning process activities, schedules, responsibilities, and personnel required during commissioning.
   4. List of equipment and systems to be tested with description of tests to be performed. Include an explanation of the original design intent.
   5. List of functions to be tested, including calibration and economizer controls.
   6. List of conditions under which the tests shall be performed.
   7. List of measurable criteria for performance.

C. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
   1. System name.
   2. List of devices.
   3. Step-by-step procedures for testing each controller after installation, including:
      a. Process of verifying proper hardware and wiring installation.
      b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
      c. Process of performing operational checks of each controlled component.
      d. Plan and process for calibrating valve and damper actuators and all sensors.
      e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
   4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
   5. Description of the instrumentation being used for testing.

6. Indicate the tests required on each system that should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

D. Submit startup reports pre-functional tests, and trend logs for review by the Commissioning Authority.

E. Submit a copy of the preliminary commissioning report. Preliminary commissioning report shall include the following:
1. Results of preliminary functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
3. Completed Commissioning Compliance Checklist.
4. Itemization of deficiencies found during testing that have not been corrected at the time of preliminary commissioning report preparation.
5. List of deferred tests that cannot be performed at the time of preliminary commissioning report preparation because of climatic conditions.
6. List of climatic conditions required for the performance of the deferred tests.

F. Submit a final commissioning report that includes the following:
1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
3. Itemization of resolved deficiencies found during preliminary commissioning.
4. Submit report to the Engineer and Owner within 90 days of the date of receipt of the certificate of occupancy.

G. Project Record Documents:
1. Submit as-built drawings indicating changes that occurred during the construction phase.
2. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
3. Show actual locations of all sensors on project record drawings.

H. O&M Manual: The O&M manual shall expand upon the more traditional operating and maintenance documentation to include information gathered during the commissioning process. Include the following for each system:
1. Manufacturer information.
2. Equipment specifications and recommendations.
3. Programming procedures and data points.
4. Narratives.
5. Other means of illustrating to the Owner how the building, equipment, and systems are intended to be installed, maintained, and operated.
6. Label that includes required regular maintenance actions for equipment and systems.
   a. Include in the label the title or publication number for the O&M manual for the model and type of product.
7. As-built control schematics for each commissioned system.
8. As-built control sequences for each commissioned system, including final setpoints and list of all control points.
9. Final parameters of all peripheral equipment (e.g., final parameters resident in a VFD).

10. Recommended operating procedures for each piece of primary equipment.
11. Instructions for integrated building systems.
12. Recommended schedule of maintenance requirements and frequency, troubleshooting guidelines, and emergency procedures.
13. PRODUCTS

1.07 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing. Unless otherwise noted such testing equipment will NOT become the property of Owner.

B. If not otherwise specified, provide test equipment certified and calibrated within the past year of use. Meet the following minimum accuracy requirements:
   1. Temperature sensors and thermometers: Accuracy of plus/minus 0.5 degrees F and resolution of plus/minus 0.1 degrees F.
   2. Pressure sensors: Accuracy of plus/minus 2.0 percent of value within the range of values being measured (not full range of sensor).

C. Equipment-Specific Tools: Where special testing equipment, tools, and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work. Such equipment, tools, and instruments shall become the property of Owner.

PART 2 EXECUTION

2.01 COMMISSIONING PROCESS OVERVIEW

A. The following narrative provides a brief overview of the typical commissioning tasks performed during the design, construction, acceptance, and post-occupancy phases and the general order in which they occur. Coordinate with the CxA to comply with the commissioning requirements of the project.
   1. Owner furnishes documentation to support the OPR and BOD to the design team and CxA.
   2. The design team prepares construction documents to meet the OPR and BOD.
   3. The CxA develops the commissioning plan.
   4. Plans are permitted and construction-related submittals for all commissioned equipment are provided to the CxA during the normal submittal process.
   5. The CxA develops specific equipment PFCs and furnishes them to the contractor.
   6. The CxA conducts a kick-off meeting early during construction and presents the commissioning process for the project.
   7. The Contractor coordinates project construction and prepares the project for inspecting, acceptance testing, and PFCs.
   8. The Contractor coordinates with the CxA to execute and document the PFCs. The CxA reports on the PFC process including an issues report.
   9. PFCs are completed before start-up, testing and balancing, and functional testing.
   10. The Contractor and responsible subcontractors shall document equipment start-up and initial checkout with assistance from manufacturer’s technicians. The CxA may request copies of the manufacturer’s or contractor’s field start-up reports.

11. The CxA develops specific FPT plans for review by the Engineer, Contract Administrator and responsible subcontractors.
12. The Contractor coordinates TAB for the project.
13. Testing, adjusting and balancing of completed HVAC systems is completed and verified by the CxA.
14. The Contractor and responsible subcontractors complete the installation and checkout of all building control systems.
15. The CxA coordinates and executes the FPTs with the assistance of responsible subcontractors. The CxA reports on the testing process including all observed deficiencies.
16. The CxA develops a preliminary commissioning report.
17. Testing of other commissioned systems not requiring formal functional testing is completed.
18. The CxA reviews close-out documentation and schedules deferred testing.
19. The Contractor and CxA coordinate to compile the O&M manual.
20. The CxA verifies training as required by the Contract Documents is completed.
21. The CxA develops a final commissioning report.

B. PREPARATION

C. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

D. Furnish additional information requested by the Commissioning Authority.

E. Prepare a preliminary schedule for use by the Commissioning Authority. Develop the following schedules and update the schedule as appropriate during the course of construction:
1. Leakage testing of duct systems.
2. Pressure testing of piping systems.
3. Flushing and cleaning piping systems.
4. Equipment startup.
5. Testing, adjusting, and balancing systems.

F. Notify the Commissioning Authority when scheduled tests shall occur. When commissioning activities not yet performed or not yet scheduled will delay construction, notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

G. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.

H. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

I. Provide temperature and pressure taps in accordance with the contract documents.
1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

2.02 INSPECTING AND TESTING - GENERAL

A. Refer to the latest adopted edition of the applicable energy code for more information.

2.03 PREFUNCTIONAL CHECKOUT

A. Submit startup plans, startup reports, and PFCs for each item of equipment or other assembly to be commissioned.

B. PFCs shall demonstrate the commissioned equipment is properly installed and ready for startup and initial operation.

C. Perform the PFCs directed by the CxA for each item of equipment or other assembly to be commissioned.

D. Document items from the PFCs and startup that were not completed successfully.

E. Complete and submit all PFC forms and provide notice that the equipment is ready for testing, adjusting, and balancing.

F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

2.04 TESTING AND BALANCING COORDINATION

A. Coordinate commissioning schedule with TAB schedule.

B. Notify the CxA at least 7 days in advance of testing and balancing work. Provide access for the CxA to witness test TAB work.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. All required Prefunctional Checklists, calibrations, startup, and component Functional Tests of the system shall be completed and approved by the CxA prior to starting TAB.

E. Coordinate with the BAS and TAB Contractor to make available technicians, instrumentation, and tools to assist the CxA in verification of data points associated with TAB of HVAC systems.

2.05 FUNCTIONAL PERFORMANCE TESTING

A. The CxA shall furnish FPT procedures to the subcontractors and equipment manufacturers for review for feasibility, safety, equipment, and warranty protection.

B. Perform the FPTs directed by the CxA for each item of equipment or other assembly to be commissioned, including equipment, controls, and economizers. FPTs shall demonstrate the following:
   1. The operation, function, and maintenance serviceability for each commissioned equipment, component, and system is confirmed according to the approved plans and specifications.
   2. The sequence of operations, including modes, backup modes (if applicable), alarms, and mode of operation upon a loss of power and restoration of power for each control device, equipment, component, and system. Reference section Control System Functional Testing below for more information.
   3. Control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with the approved plans and specifications.
   4. Air economizers operated in accordance with manufacturer’s specifications and specified sequence of operation.

5. Terminal units: For multiples of like equipment (VAV terminal units, unit heaters, etc.), commission a minimum of 50 percent of total number of units.

C. Coordinate with the responsible sub-contractors to provide trained technicians to perform commissioning tests and/or coordinate with equipment manufacturers to make available authorized technicians for the same purpose.

D. Test equipment under design conditions when possible. Impose simulated design conditions using an artificial load when it is not practical to test under design conditions. Provide additional equipment to impose simulated loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
1. The CxA may direct that set points be altered when simulating conditions is not practical.
2. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

E. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

F. If the Commissioning Plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

2.06 DEFERRED AND SEASONAL TESTING

A. If any PFC or FPT cannot be completed due to an unforeseen condition not within control of the Contract Administrator, defer execution of the PFC or FPT based on the recommendation of the CxA and approval of the Owner. Complete the affected testing as soon as practical.

B. During the warranty period, complete tests purposely delayed until weather conditions are closer to the system's design conditions. The CxA shall coordinate this activity. Any final adjustments to the O&M manuals and/or as-built drawings due to the testing shall be made by the CA.

2.07 OPERATION AND MAINTENANCE MANUALS

A. See Division 01 and Section "General Mechanical Requirements for HVAC" for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

2.08 DEMONSTRATION AND TRAINING

A. See Division 01 for additional requirements.

B. Complete all related commissioning requirements prior to final inspections.

C. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

D. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

E. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.

F. Provide the services of manufacturer representatives to assist instructors where necessary.

G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

H. Document systems operations training in the commissioning report.

END OF SECTION 230800

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SECTION 230913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Control dampers.

B. Operators.

C. Input/Output sensors and transmitters.

D. Thermostats.

1.02 DEFINITIONS

A. BAS: Building Automation System.

B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations.

C. Cv: Design Valve Flow Coefficient.

D. DDC: Direct Digital Control.

E. EPDM: Ethylene Propylene Diene Monomer.

F. High voltage: 50 volts or higher.

G. Low voltage: Below 50 volts.

H. PTFE: Polytetrafluoroethylene.

I. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

1.03 CONTRACTOR RESPONSIBILITIES

A. Reference Division 23 Section “Electrical Coordination for Mechanical Equipment” for contractor responsibilities.

B. BAS Contractor:
   1. Installation of the BAS shall be by the BAS Contractor or their subcontractors.
   2. Low voltage control wiring.
   3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.

4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.
7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.
8. Perform startup and demonstration services as specified in Section "Direct Digital Control for HVAC".

C. Sheet Metal Contractor:
1. Installation of automatic control dampers, smoke control dampers, and necessary blank off plates.
2. Access doors where and as required.

D. Mechanical Contractor:
1. Installation of immersion wells.
2. Installation of flow switches.
3. Installation of automatic control valves.
4. Installation of pressure tappings and associated shut-off cocks.
5. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. Control valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI and MSS standards.

D. Measurement devices and sensors shall be calibrated using NIST traceable standards.

1.05 WARRANTY

A. Correct defective Work within a one year period after Substantial Completion.

B. Existing Equipment Warranty: Contractor shall maintain and provide a standard 12 month warranty for any existing equipment, valves, actuators, devices, sensors, transmitters, and thermostats that are selected to be reused for the project. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of system startup and demonstration.

C. Provide extended warranty for control devices and equipment as specified herein.

PART 2 PRODUCTS AND MATERIALS

2.01 CONTROL DAMPERS

A. Dampers shall be factory fabricated and sized as shown on drawings and as specified.

B. Individual damper sections shall not be larger than 48 inches x 60 inches. Provide a minimum of one damper actuator per section.

C. Performance: Test in accordance with AMCA 500-D.
   1. Pressure Drop: Unless otherwise scheduled or indicated on the Drawings, size control dampers as follows:
      a. Modulating Dampers: Provide dampers with linear flow characteristics. Size modulating dampers based on the smaller of the following.
         1) Maximum velocity of 1,500 feet per minute.
         2) Maximum Full-open air pressure drop of 0.1 inches W.C.
      b. Two Position Dampers: Dampers shall be full duct size and selected to minimize pressure drop.
   2. Leakage:
      a. Motorized dampers for outdoor, exhaust and relief air and for shaft and stairway vents shall be Class I leakage and shall not exceed 4.0 CFM/square foot in full closed position at 1 inch W.G. pressure differential across damper.
      b. Motorized dampers for other applications shall be Class II leakage.

D. Frames: Galvanized steel, extruded aluminum, or stainless steel, welded or riveted with corner reinforcement.
   1. Use minimum 16 gauge for rectangular dampers.
   2. Use minimum 20 gauge for round dampers.
   3. For aluminum frames, use 1/8 inch thick material.
   4. All damper frames shall have a flange for duct mounting.
   5. Reference Part 3 Execution for application of the material type.

E. Blades: Galvanized steel, extruded aluminum, or stainless steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.
   1. Use minimum 16 gauge for rectangular dampers.
   2. Use minimum 16 gauge for round dampers.
   3. For aluminum blades, use 1/8 inch thick material.
   4. The blades shall be suitable for the air velocities to be encountered in the system.
   5. Dampers longer than the maximum blade length shall be fabricated in sections.
   6. Reference Part 3 Execution for application of the material type.

F. Blade Seals: Synthetic elastomeric inflatable or Neoprene, mechanically attached, field replaceable.
   1. Installed along the top and bottom of the frame and on all mating surfaces.

G. Jamb Seals: Spring stainless steel.
   1. Installed inside the frame sides.

H. Shaft Bearings: One of the following as recommended by manufacturer for the application:
   1. Oil impregnated sintered bronze.
   2. Graphite impregnated nylon sleeve with thrust washers at bearings.

3. Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
4. Molded synthetic bearings.

I. Linkage Bearings: One of the following as recommended by manufacturer for the application:
1. Oil impregnated sintered bronze
2. Graphite impregnated nylon.

J. Maximum Pressure Differential: 6 inches wg.

K. Temperature Limits: -40 to 200 degrees F.

L. Manufacturers:
1. Greenheck.
2. CESCO.
3. Pottorff.
4. Nailor.
5. Ruskin.

M. Reference the Damper Schedule in Part 3 for basis of design damper model and material for the application.

N. Extended Warranty: Control dampers utilized in an economizer assembly shall be covered with minimum 5 year manufacturer warranty, certified to operate through 60,000 damper opening and closing cycles, and certified to meet leakage requirements specified above.

2.02 OPERATORS

A. General:
1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.
   a. Reference Part 3 for Damper Operator Voltage Schedule.
2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
3. Construction:
   a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
   c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
4. Field Adjustment:
   a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
   b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
5. Two-Position Actuators: Single direction, spring return or reversing type. End-switches shall be integral to the actuator to determine actuator status.
6. Position Feedback:

a. Where indicated on the controls drawings, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
b. Where indicated on the controls drawings, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
c. Actuator shall contain position indicator and graduated scale indicating open and closed travel limits.

7. Integral Overload Protection:
   a. Provide against overload throughout the entire operating range in both directions.
   b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
8. Attachment:
   a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
   b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.
9. Temperature and Humidity:
   a. Temperature: Suitable for operating temperature range encountered by application.
   b. Humidity: Suitable for humidity range encountered by application, non-condensing.
10. Enclosure:
    a. Suitable for ambient conditions encountered by application.
11. Stroke Time:
    a. Coordinate with stroke time indicated on the control drawings.
    b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.

B. Damper Operators:
1. Controls contractor shall size damper operator.
2. Sizing: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
   a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
   b. Provide one operator for maximum 20 sq ft damper section or maximum 7 in-lb/sq ft damper area.
3. Fail Positions:
   a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection. Normal positions are indicated on the control drawings.
      1) Return air damper, normally open.
      2) Outside air damper, normally closed.
      3) Exhaust/Relief air damper, normally closed.
   b. Operator shall fail in place for all other applications not listed under spring return.

C. Manufacturers:
1. Damper Operators:
   a. Belimo.
   b. Honeywell.
   c. Johnson Controls.
   d. Schneider Electric (Invensys).

e. Siemens.

2. Valve Operators:
   a. Belimo.
   b. Bray.
   c. Danfoss.
   d. Fisher Controls.
   e. Honeywell.
   f. Johnson Controls.
   g. Schneider Electric (Invensys).
   h. Siemens.

2.03 INPUT/OUTPUT SENSORS AND TRANSMITTERS

A. General:
   1. Performance Requirements:
      a. Device must be compatible with project DDC controllers.
      b. Elements used shall be general-purpose type.
      c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.
         1) Transmitters and transducers shall have offset and span adjustments.
         2) Shock and vibration shall not harm the transmitter or transducer.
         3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.
      d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.
   2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
   3. Input Power: Low voltage, nominal 24 Vdc.

B. Temperature Sensors:
   1. General: Temperature sensing elements shall have characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
   2. Performance Requirements:
      a. Thermistor:
         1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
         2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
         3) Resolution: Plus/minus 0.2 degrees F minimum.
         4) Heat Dissipation Constant: 2.7 mW per degree C.
         5) Drift: 0.04 degree F after 10 years within temperature range.
      b. RTD:
         1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
         2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.
            a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
            b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.
            c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.

3) Resolution: Plus/minus 0.2 degree F.
4) Drift: 0.04 degrees F after 10 years within temperature range.

c. Sensing Range:
1) Provide limited range sensors if required to sense the range expected for a respective point.

d. Wire Resistance:
1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.

3. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
4. Room Temperature Sensors:
a. Construct for surface or wall box, or enclosure with insulated backing suitable for exterior wall mounting.
5. Temperature Averaging Elements:
a. Use on duct sensors for ductwork 10 sq ft or larger.
b. Use averaging elements where prone to stratification with sensor length range between 16-22 ft.
c. Provide for all mixed air and heating coil discharge sensors regardless of duct size.
6. Insertion Elements:
a. Use in ducts not affected by temperature stratification or smaller than 10 sq ft.
b. Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches for pipe sizes greater than 4 inches.
c. Immersion Well Housing: 1/2 inch NPT brass or stainless steel. Stainless steel required for piping 6 inch and larger.

C. Humidity Sensors:
1. Elements: Accurate within 3 percent full range with linear output.
a. Accuracy shall include temperature effects.
2. Resolution: Plus/minus 1 percent.
3. Drift: Less than 1 percent full scale per year.
4. Sensing Range: 0 to 100 percent relative humidity.
5. Room Sensors: Provide housing with integral sensor. Housing shall be plastic, NEMA 250, Type 1. Provide with insulated backing suitable for exterior wall mounting.
6. Duct Sensors: Insertion type probe with mounting plate. Housing shall be metal, NEMA 250, Type 1.
7. Outside Air Sensors: With element guard and mounting plate.

D. Equipment Operation Sensors:
1. Status Inputs for Airside Equipment:
a. Type: Fixed range differential pressure switch with adjustable setpoint.
b. Performance Characteristics:
1) Range: Not greater than two times the design fan static pressure.
c. Construction:
1) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered.
2) Provide Insertion tube for use in duct configurations. Insertion length selected as appropriate for duct size.

3) Contact Type: Single-pole, single-throw (SPST). Provide multiple poles or throw contacts to meet additional alarms required.

2.04 POWER SUPPLIES

A. Reference Division 23 Section “Direct Digital Controls for HVAC” for DC power supply requirements.

B. Control power transformers shall meet NEMA/ANSI standards.

C. Control power transformers shall be UL listed for Class 2 current-limited service or provided with over-current protection on both primary and secondary circuits for Class 2 current-limited service.

D. Connected load on the transformer shall not exceed 80 percent of the transformer’s rated capacity.

E. The core and windings shall be completely encased in a UL approved thermoplastic. No metal parts shall be exposed other than the terminals.

F. Performance Characteristics:
1. Accuracy: Plus/minus 1 percent at 5.0 A full scale output.

G. Provide a disconnect switch for each transformer.

2.05 THERMOSTATS

A. General:
1. Programmable, with the following features:
a. LCD or LED display screen.
b. Button our touch-screen Interface.
c. 7-day programmable scheduling.
d. Temperature information display.
e. Setpoint display and adjust.
f. Operation mode display and adjust.
g. Override.
h. Remote temperature sensor interface terminal.
i. Lockout.

B. Airstream Thermostat:
1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
2. Averaging service remote bulb element: minimum 7.5 feet or length as required to fit duct.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.

B. General Workmanship:
1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
3. Install all equipment in readily accessible locations.
4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
5. Install all products in accordance with manufacturer's instructions.

C. Sensors:
1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
2. Provide thermistor type temperature sensors for temperature ranges between minus 30 degrees F to 230 degrees F. Provide RTD type temperature sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate installation of room/space sensors with architect and other trades to ensure a neat and orderly installation.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5. Sensors used in mixing plenums and hot and cold decks shall be of averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each square foot of coil area.
7. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 feet downstream.
8. Install temperature, humidity, and smoke detectors for both supply air and return air applications a minimum of 10’-0” downstream or upstream of the air handling unit and prior to any branch duct takeoffs.
9. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
10. Install outdoor air temperature sensors on north wall, complete with sun shield where shown on the plans. If not shown, locate sensors in an accessible location, a minimum of 15 feet away from exhaust or relief air locations.

11. Adjust flow switch to meet sensitivity required to ensure minimum flow through the equipment.
12. Verify location and mounting height of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Align with adjacent lighting switches and humidistats.
    a. Install devices to meet ADA requirements unless otherwise noted on the plans.
13. Mount freeze protection thermostats using flanges and element holders.
    a. Install thermostat completely across the surface the thermostat serves.
14. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
15. Provide separable sockets for liquids and flanges for air bulb elements.
16. Provide guards on thermostats in areas indicated on the drawings.
17. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
18. Install shutoff valves in the high and low pressure reference lines connecting to hydronic pressure sensors and switches. Install a shunt valve across the high and low reference pressure ports for servicing. Valves may be ordered as an integral option with the sensor.

D. Control Dampers:
1. Install dampers with extruded aluminum or stainless steel frames and blades in corrosive environments and areas with high humidity.
2. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
3. Clearance:
    a. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
    b. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
4. Service Access:
    a. Dampers and actuators shall be accessible for visual inspection and service.
    b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Division 23 Section, “Air Duct Accessories.”.
5. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting.
6. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
7. Provide mixing dampers of parallel blade construction arranged to mix streams. Where shown on the drawings, provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
8. Provide isolation (two position) dampers of parallel blade construction.
9. Provide opposed blade damper configuration for all other applications.
10. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
11. After installation of low-leakage dampers and seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Operators:

1. Mount and link control damper actuators according to manufacturer's instructions.
   a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
   b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
   c. Provide all mounting hardware and linkages for actuator installation.
2. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.
3. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer.

3.03 MAINTENANCE

A. Refer to Division 01 closeout requirements for additional requirements relating to maintenance service.

B. Provide service and maintenance of control system for one year from Date of Substantial Completion.

C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

3.04 STARTUP AND DEMONSTRATION

A. Control Dampers and Valves:
   1. Stroke and adjust control valves and dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
   2. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
   3. For control valves and dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
   4. Verify that all two-position dampers and valves operate properly and that the normal positions are correct.
   5. Verify that all modulating dampers and valves are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.

B. PI Control Valves:
   1. Field verify installation and operating differential pressure range of all PI control valves.
   2. Verify total system flow to be within plus/minus 10 percent of system design.
   3. Individual field adjustments for the PI control valve assembly shall be performed using the PI control valve manufacturer's documented procedures.

3.05 DAMPER SCHEDULE

SERVICE	RUSKIN MODEL	MATERIAL
Outside, Exhaust and Relief		

Air Control, Stairway and Shaft Vents	CD-50	Aluminum
Fire/Smoke Damper for Smoke Control	FSD-60	Galvanized Steel
Smoke Damper for Smoke Control	SD-60	Galvanized Steel
Corrosive Environments	CD-50-CE	Aluminum
Corrosive Environments	CD-36-CE	Stainless Steel
All Other	CD-356	Galvanized Steel

3.06 DAMPER OPERATOR VOLTAGE SCHEDULE

SERVICE	VOLTAGE
Interlocked with HVAC fans	120V
Multi-section dampers	120V
Large dampers (> 60 inches in any dimension)	120V
All other operators control wiring	24V

1. Note: Coordinate with Division 26 if 120V power is required for operator to achieve appropriate torque requirements for damper actuation.

END OF SECTION 230913

SECTION 232300
REFRIGERANT PIPING

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Piping.

B. Moisture and liquid indicators.

C. Valves.

D. Strainers.

E. Check Valves.

F. Pressure regulators.

G. Pressure relief valves.

H. Filter-driers.

I. Solenoid valves.

J. Expansion valves.

K. Flexible connections.

1.02 SUBMITTALS

A. Product Data: Provide general assembly of valves and specialties, including manufacturer’s catalog information. Provide manufacturer’s catalog data including load capacity.

B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment.

C. Test reports specified in Part 3 below.

D. Manufacturer’s Installation Instructions: Indicate support requirements, connection requirements and isolation requirements for servicing.

E. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.

F. Maintenance Data: Include maintenance instructions for refrigerant valves and piping specialties, for inclusion in Operation and Maintenance manual.

1.03 QUALITY ASSURANCE

A. Comply with Division 23 Section, “Basic Piping Materials and Methods.”

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, and maintain sealed until connected into system.

PART 2 PRODUCTS AND MATERIALS

2.01 REGULATORY REQUIREMENTS

A. Comply with ASME/ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.

B. Comply with ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.

C. Comply with applicable Mechanical Code.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.02 PIPING

A. Copper Tubing:
   1. ASTM B280, Type ACR, seamless, hard-drawn straight lengths and soft-annealed coils. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.
   2. ASTM B88, Type L, seamless, hard-drawn straight lengths and soft-annealed coils.
   3. ASTM B88, Type K, seamless, hard-drawn straight lengths and soft-annealed coils.

B. Refrigerant Line Kits:
   1. Type ACR seamless copper roll of refrigerant tubing with pipe diameters as recommended by the manufacturer and of length as required for the installation.
   2. Factory or field installed flexible unicellular insulation:
      a. Minimum thickness as required per Division 23 section “HVAC Insulation”.
   3. Quick-connect flare tubing compression fittings or solder connections as required to match the connections of the condensing unit and evaporator coil.

2.03 FITTINGS

A. Wrought-Copper Fittings for Solder-joint: ANSI B16.22, streamlined pattern.

B. Mechanical Flared Fittings: ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tube.

C. Press Fit and Mechanically Attached Fittings:
   1. Acceptable Manufacturers:
      a. Conex Banninger-Maxipro ACR.
      b. Parker-ZoomLock.
      c. Rapid Locking System.
      d. Refrigerant Coupling Systems (RCS).
   2. Fittings shall be approved with copper tubing conforming to ASTM B280, B88 or B743.
   3. Fittings shall be approved with hard (drawn) and soft (annealed) copper tubing Type ACR, L and K.
   4. Fittings shall be rated for continuous operating temperature from -40 F to 250 F and maximum operating pressure of 700 psi.
   5. Fittings shall be compatible with the oils and lubricants used in the refrigerant.

2.04 JOINING MATERIALS

A. Refer to Division 23 Section “Basic Piping Materials and Methods” for joining materials.

2.05 PIPE SUPPORTS

A. Hanger, supports, and anchors are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing. Provide plastic galvanic isolators for copper tubing where indicated.

2.06 MOISTURE AND LIQUID INDICATORS

A. Manufacturers
   1. Emerson Electric.
   2. Henry Technologies.
   3. Parker Hannifin/Refrigeration and air Conditioning.
   4. Sporlan, Division of Parker Hannifin.

B. Moisture/liquid Indicators: Single port type, UL listed, with forged brass body, solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; rated for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.07 SHUT OFF VALVES

A. Manufacturers:
   1. Danfoss.
   2. Emerson Electric.
   3. Henry Technologies.
   4. Parker Hannifin/Refrigeration and air Conditioning.
   5. Sporlan, Division of Parker Hannifin.

B. General: Complete valve assembly shall be UL-listed and designed to conform to AHRI 760. Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

C. Diaphragm Packless Valves: Globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F

D. Ball: Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seal; maximum working pressure 500 psig and maximum temperature of 275 F.

E. Globe: Cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections; for maximum working pressure of 500 psig and maximum operating temperature of 275 deg. F.

2.08 STRAINERS

A. Manufacturers:
1. Danfoss.
2. Parker Hannifin/Refrigeration and air Conditioning.
3. Sporlan, Division of Parker Hannifin.

B. Strainers: 500 psig maximum working pressure; forged brass body with Monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

2.09 CHECK VALVES

A. Manufacturers:
1. Danfoss.
2. Parker Hannifin/Refrigeration and air Conditioning.
3. Sporlan, Division of Parker Hannifin.

B. Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze or forged brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

C. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

2.10 PRESSURE REGULATING VALVES

A. Manufacturers:
1. Danfoss.
2. Emerson Electric.
3. Parker Hannifin/Refrigeration and air Conditioning.

4. Sporlan, Division of Parker Hannifin.

B. Evaporator Pressure Regulating Valves: Pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.

2.11 PRESSURE RELIEF VALVES

A. Manufacturers:
1. Danfoss.
2. Parker Hannifin/Refrigeration and air Conditioning.
3. Sporlan, Division of Parker Hannifin.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.12 FILTER DRIERS

A. Manufacturers:
1. Danfoss.
2. Emerson Electric
3. Parker Hannifin/Refrigeration and air Conditioning.
4. Sporlan, Division of Parker Hannifin.

B. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:
1. Standard capacity desiccant sieves to provide micronic filtration.

C. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg. F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

D. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets.

2.13 SOLENOID VALVES

A. Manufacturers:
1. Danfoss.
2. Emerson Electric.
3. Parker Hannifin/Refrigeration and air Conditioning.
4. Sporlan, Division of Parker Hannifin.

B. Valves: 250 deg. F temperature rating, 500 psig working pressure; forged brass body, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve.

C. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

2.14 THERMOSTATIC EXPANSION VALVES

A. Manufacturers:
   1. Danfoss.
   2. Emerson Electric.
   3. Parker Hannifin/Refrigeration and air Conditioning.
   4. Sporlan, Division of Parker Hannifin.

B. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, and an external equalizer line.

C. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select valve to avoid being undersized at full load and excessively oversized at part load.

PART 3 EXECUTION

3.01 PIPE APPLICATION SCHEDULE

A. Above Grade:
   1. Type L or Type ACR tubing.

B. Below Grade and Within Slabs:
   1. Use Type K tubing for 2 inch and smaller without joints. Mechanical fittings (crimp or flare) are not permitted.
   2. Install tubing in insulated PVC or HDPE protective conduit. Vent conduit to the outdoors.

C. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

D. At contractor’s option, use refrigerant line kits for refrigerant systems of 5 tons and smaller capacity.

3.02 PIPE IDENTIFICATION

A. Reference Division 23 Section “Identification for HVAC Piping and Equipment” for piping identification requirements.

3.03 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer’s instructions.

B. Install piping to ASME B31.9 requirements.

C. Reference Division 23 Section “Basic Piping Materials and Methods” for general piping installation requirements.

D. Do not install PVC or non-plenum rated HDPE piping in return air plenums.

3.04 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration" and the equipment manufacturer’s installation requirements.

B. Install piping in as short and direct arrangement as possible to minimize pressure drop.

C. Install piping for minimum number of joints using as few elbows and other fittings as possible.

D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

F. Insulate piping per Division 23 Section “HVAC Insulation.”
   1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

I. Slope refrigerant piping as follows:
   1. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
   2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
   3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

J. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

K. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

3.05 HANGERS AND SUPPORTS

A. Comply with the requirements of Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

B. Install the following pipe attachments:

1. Provide insulation saddles and protection shields as specified in Section "Hangers & Supports for HVAC Piping & Equipment". Provide insulation inserts as specified in Section "HVAC Insulation".

C. Install hangers with the following minimum rod sizes and maximum spacing:

NOM. PIPE SIZE	MAX. SPAN-FT	MIN. ROD SIZE – INCHES
Up to 3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8
2-1/2	9	1/2
3	10	1/2
4	12	1/2
6	14	5/8

D. Support vertical runs at each floor. Support riser piping independently of connected horizontal piping.

E. Install a support within one foot of each change of direction.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.06 PIPE JOINT CONSTRUCTION

A. Reference Division 23 Section, "Basic Piping Materials and Methods" for basic pipe joint construction.
   1. Joints with Press-Fit and Mechanically Attached Fittings: Install fittings in accordance with manufacturer's written instructions.
      a. Installers of these fittings shall be trained using manufacturers training tools prior to installing any fittings.
      b. Provide sufficient length of copper piping at connections to equipment to facilitate the installation of these fittings using the manufacturer's recommended tools.
      c. Prepare the copper tube in accordance with manufacturer's instructions.
      d. Install fittings to minimum depth required by the fitting manufacturer.
      e. Crimp or mechanically attach the fittings only using the crimping or press clamp tools allowed by the manufacturer using the jaw size appropriate for the tube diameter.
      f. Verify the fittings are properly installed using crimp gauges or manufacturer's approved verification methods.

3.07 VALVE AND PIPING SPECIALTIES INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve . Install solenoid valves in horizontal lines with coil at the top.
   1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
   1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
   2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
   3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
   4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

F. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

G. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
   1. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

3.08 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow servicing and maintenance.

3.09 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI. Provide test report summarizing the test procedures and results of the tests.

B. Repair leaking joints using new materials, and retest for leaks.

C. Field Test: Every refrigerant-containing part of every system that is erected on the premises, except safety devices, pressure gauges, control mechanisms, compressors, evaporators, and systems that are factory-tested, shall be tested and proved tight after complete installation and before operation. The high side and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high side and low side of the system, respectively.

D. Testing Procedure: Tests shall be performed with dry nitrogen. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gage on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system’s components.

3.10 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:
   1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
   2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.11 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems in accordance with requirements of Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.12 STARTUP

A. Charge system using the following procedure:
   1. Install core in filter dryer after leak test but before evacuation.
   2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
   3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
   4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
   5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
   6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals. Refer to Division 01 section "Closeout Procedures."

D. Schedule training with Owner through the Architect, with at least 7 days advance notice.

END OF SECTION 232300

SECTION 233113
METAL DUCTS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Duct liner.

C. Duct sealants.

D. Duct hangers and supports.

E. Wire rope hanging system.

F. Manufactured ductwork and fittings.

G. Factory-fabricated grease exhaust ductwork.

H. Snap-Lock duct system.

I. Modular ductwork and fittings.

1.02 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
   1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
   2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.04 SUBMITTALS

A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
   1. Duct Liner.
   2. Sealing Materials.

3. Fire-Stopping Materials.
4. Duct Cleaning Products.

B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire-rated and other partitions.
7. Terminal heating and cooling unit, coil, humidifier and duct silencer installations.
8. Locations of fire and fire/smoke dampers and associated duct access doors.
9. Locations of cleanout and access doors in grease exhaust ducts.
10. Location of manual balancing dampers.
11. Duct smoke detector locations. Refer to electrical drawings for general locations and coordinate locations with the electrical contractor.
12. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:
1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

D. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

F. Duct Cleaning Plan: Submit written work plan including the following information:
1. Scope of work identifying components that will be cleaned.
2. Identify specific environmental engineering controls required for area of work.
3. Detail the cleaning work means and methods.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

D. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

E. NFPA Compliance: Comply with the following NFPA Standards:
   1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
   2. NFPA 90B, “Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
   3. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

F. Sheet Metal and Air Conditioning Contractors’ National Association, Inc. (SMACNA): Provide ductwork systems in conformance with “HVAC Duct Construction Standards – Metal and Flexible,” latest edition.

G. Underwriter’s Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.

H. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork systems in accordance with the standard Assessment, Cleaning and Restoration of HVAC Systems (ACR 2002).

1.06 PROTECTION AND REPLACEMENT

A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.

B. Replace duct liner that is damaged and cannot be repaired satisfactorily, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installing new duct liner.

1.07 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS AND MATERIALS

2.01 DUCT ASSEMBLIES

A. Ducts: Galvanized steel, unless otherwise indicated. Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A700.

B. Supply Air Ducts (constant volume or single zone VAV systems): 3 inches w.g pressure class, galvanized steel.

C. Return and Relief: 2 inch w.g. pressure class, galvanized steel.

D. General Exhaust: 2 inch w.g. pressure class, galvanized steel.

E. Type II (Cooking) Hood Exhaust Duct: 2 inch w.g. pressure class, rigid metallic material complying with SMACNA and Mechanical code.
   1. Galvanized Steel.
   2. Stainless Steel.
   3. Aluminum.
   4. Seal ducts with welds, gaskets, mastics, liquid sealants or tapes.

F. Type I (Grease) Hood Exhaust Ducts: 2 inch w.g. pressure class, comply with NFPA 96.
   1. Concealed: Carbon-steel sheet, minimum 16 gauge.
   2. Exposed:
      a. Interior to the Building: Type 304, stainless steel, minimum 18 gauge, with finish to match kitchen equipment and range hood.
      b. Exterior to the Building:
         1) Type 304, stainless steel, minimum 18 gauge.
         2) Carbon-steel sheet, minimum 16 gauge, coated with an exterior rated, high temperature corrosion resistant paint.
   3. Weld and flange seams and joints.
   4. At Contractor's option, a UL listed concentric ductwork package may be used in lieu of the welded carbon or stainless steel duct for connecting hood to exhaust fan. Provide manufacturers UL listing number and verification certificate as a part of the shop drawing submittal. Install duct package in strict conformance with manufacturer's instructions and recommendations.

G. Outside Air Intake: 2 inch w.g. pressure class, galvanized steel.

H. Combustion Air: 2 inch w.g. pressure class, galvanized steel, aluminum or stainless steel.

I. Transfer Air and Sound Boots: 1/2 inch wg pressure class, galvanized steel.

J. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph “Seam and Joint Sealing”.

K. Duct Liner Application: Provide duct liner on the following air ducts and where specified on the drawings.
   1. Supply Ductwork:

a. First 15 feet of ductwork downstream of equipment outlets including exterior ductwork. Refer to Section "HVAC Insulation" for additional insulation requirements for exterior ductwork.

2. Return Ductwork.
   a. First 15 feet of ductwork upstream of equipment outlets including exterior ductwork. Refer to Section "HVAC Insulation" for additional insulation requirements for exterior ductwork.

2.02 MATERIALS

A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A700.

B. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, lock-forming quality with G90/Z275 coating.. Provide mill phosphatized or galvanized finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.

C. Carbon Steel for Ducts: ASTM A1008/A1008M, Designation CS (commercial steel), cold-rolled, with oiled, exposed matte finish.

D. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength, with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.

E. Stainless Steel for Ducts: ASTM A 480, Type 316, with No. 4 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.

F. PVC-Coated Galvanized Steel: UL-181 Class 1 Listing. Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, lock-forming quality with G90/Z275 coating. Provide with factory-applied, 4-mil, PVC coating on exterior of ducts and fittings for underground applications, and the interior of ducts and fittings for fume-handing applications and 2-mil PVC coating on the reverse side of the ducts and fittings.

G. Duct Liner
   1. General:
      a. Comply with NFPA Standard 90A and North American Insulation Manufacturers Association (NAIMA) Standard AHC-101.
      b. Liner shall have a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84 or UL 723.
      c. Duct sizes on mechanical plans indicate clear inside airflow dimensions. Sheet metal sizes for ductwork with duct liner shall be increased accordingly to account for liner thickness.
   2. Fiberglass: ASTM C1071, Type I or II, glass fibers firmly bonded together with a thermosetting resin with surface exposed to airstream coated to prevent erosion of glass fibers. Liner surface shall serve as a barrier against infiltration of dust and dirt, shall meet ASTM C 1338 for fungi resistance and shall be cleanable using duct cleaning methods and equipment outlined by NAIMA Duct Cleaning Guide. Duct liner shall be rated for air velocity of 6,000 fpm.

a. Rectangular fiberglass duct liner shall be Certainteed ToughGard T, JohnsManville Linacoustic RC, Knauf Atmosphere, Owens Corning QuietR or approved equal.
   1) Thickness and Density:
      a) 1 inch, 1-1/2 pounds per cubic foot.
b. Round fiberglass duct liner shall be Certainteed ToughGard UltraRound, JohnsManville Spiracoustic Plus, Owens Corning QuietZone Spiral, or approved equal.
   1) Thickness and Density:
      a) 1 inch, 4 pound per cubic foot.
c. Thermal Performance: Meet minimum "K-Factor" equal to 0.28 (Btu·in/h·sq ft·F) or better, at a mean temperature of 75°F and rated in installed condition in accordance with ASTM C518 and/or ASTM C177.
d. Noise Reduction Coefficient (NRC): Meet the following minimum NRC in accordance with ASTM C423 Type A Mounting:
   1) 1 Inch Thick: NRC 0.65.
e. Liner Adhesive: Comply with NFPA Standard 90A /UL 181 classified with flame spread/smoke development less than 25/50 and ASTM C 916. Adhesive shall be a minimum 35% solid content, water-based, non-oxidizing and have a service temperature of –20 to 200 F. Water-based adhesive shall be one of the following:
   1) Design Polymerics DP 2502.
   2) Duro Dyne WIT.
   3) Foster 85-60.
   4) Childers CP-127.
   5) Johns Manville SuperSeal.
   6) Hardcast Coil-Tack.
f. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
   1) Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
   2) Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

3. Flexible Elastomeric Duct Liner: Insulation material shall be a flexible, closed cell, elastomeric insulation in sheet form that complies with ASTM C534. Material shall have a maximum thermal conductivity of 0.27 Btu-in/h-sf-F and a minimum water vapor transmission of 0.08 perm-inches. Liner shall be 1 inch thick or greater to meet local code requirements.
   a. Manufacturers:
      1) Aeroflex USA, Inc Aerocel Sheet.
      2) Armacell LLC, AP Armaflex SA or Amaflex Ultra.
      3) K-Flex USA Liner Gray.
4. Flexible Elastomeric Acoustical and Conformable Duct Liner: Compliance with ASTM C 534 Grade 1, Type II or ASTM C 1534, NFPA 90A or NFPA 90B, Thickness: 1/2 inch and 1 inch, Thermal Conductivity: 0.25 BTU-in/hr sq ft F at 75 F mean temp, ASTM C 518, Noise Reduction Coefficient: 0.6, ASTM C 423, Sound Transmission Class (STC) 25, ASTM E 90, EPA registered anti-microbial additive to inhibit mold and mildew, ASTM G21.
   a. Manufacturers:
      1) Aeroflex USA, Inc PLUS Acoustical Duct Liner.
      2) Armacell LLC, AP Coilflex.

3) Approved equal.

5. Flexible Elastomeric Round or Spiral Duct Liner: Compliance with ASTM C 534 Grade 1, Type II or ASTM C 1534, NFPA 90A or NFPA 90 B, Thickness: 1 inch, Thermal Conductivity: 0.28 Btu-in/hr sq ft F at 75 F mean temp, ASTM C 518 Noise Reduction Coefficient: 0.4, ASTM C 423 Sound Transmission Class (STC) 31, ASTM E90, EPA registered anti-microbial additive to inhibit mold and mildew, ASTM G21.
   a. Manufacturers:
      1) Armacell LLC, AP Spiraflex.
      2) Approved equal.
6. Polyester Duct Liner: Duct liner shall be an engineered nonwoven, thermally bonded polyester with a smooth and durable FSK facing. Liner shall have a noise reduction coefficient of at least 0.65 per ASTM C423 and have thermal values greater or equal to an R-5 at 1 inch, R-6 at 1-1/2 inch and R-8 at 2 inch, respectively. Polyester liner must be able to withstand a constant internal temperature up to 250 F, must be compliant with Greenguard Environmental Institute, and contain zero VOCs per ASTM D5116. Liner must comply with NFPA 90A, NFPA 90 B and UL 181. Liner must meet ASTM C518 for thermal conductance properties and ASTM G-21 for fungal resistance properties. Liner must consist of at least 25 percent recycled content.
   a. Manufacturers:
      1) Ductmate Industries “PolyArmor.”
      2) Approved equal.
7. Surface Burning Characteristics: Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.
8. For Use with Flexible Ducts: UL labeled.
9. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics. Duct tape shall not be used as a sealant on any ducts.
10. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.
11. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
12. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 65 percent solids. Approved products: Design Polymerics DP 1090, Duro Dyne SGD, Fosters 32-14, or approved equal.
13. Water-Based Joint and Seam Sealant: Non-Fibrated, UL 181 listed, rated to minimum SMACNA Pressure Class of ±10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1010, Ductmate Proseal, Duro Dyne Duroseal EDS-RS, Fosters 32-18, Hardcast Iron-Grip 601, Red Devil D-Seal and United McGill United Duct Seal WB.
14. Water-Based Joint and Seam Sealant: Fiber reinforced, UL 181 listed, rated to minimum SMACNA Pressure Class of ±10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1030, Ductmate Fiberseal, Duro Dyne Duroseal EDS-RF, Fosters 32-17, Hardcast CCWI-181, Red Devil F-Seal 181 or United McGill Uni-Mastic.
15. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

16. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum 5/8 inch x 3/16 inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of –25 to 180 F. Approved Products: Design Polymerics DP 1040, Ductmate 440, and Hardcast 1104.

H. Fire Stopping
1. Fire-Resistant Sealant: Two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-Resistant Sealant: One-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
3. Products: Subject to compliance with requirements, provide one of the following:
   a. "3M Fire Stop Foam"; 3M Corp.
   b. "SPECSEAL Pensil 200 Silicone Foam"; Specify Technology, Inc.
   c. 3M Fire Stop Sealant"; 3M Corp.
   d. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
   e. "Fyre Putty"; Standard Oil Engineered Materials Co.
   f. “FS-ONE”, Hilti, Inc.

I. Hangers and Supports
1. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
2. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
3. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
4. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
   a. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
   b. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.
5. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
6. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
   a. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
   b. For stainless steel ducts, provide stainless steel support materials.
   c. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.
7. Wire Rope Hanging Systems:

a. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
b. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
c. Wire Rope: Zinc coated or galvanized steel, with wire thread type as required to support the applied working load being supported. Provide same size wire for all applications based on worst case loading.
d. Cable Lock: Cast zinc housing with steel spring with wedge grip, selected to meet the vertical load applied to the hanging system and wire thread. Do not exceed the working load limit.
e. Accessories: Hanger attachments and structural attachments shall be compatible with wire rope hanger system and shall be by the same manufacturer as the wire rope hanger system.
f. Seismic Applications: Wire rope hanger systems used for seismic supports shall be seismically tested according to ICC code guidelines EG284 with UL and SMACNA seismic approvals. Reference Division 23 Section "Seismic Controls for Mechanical Systems" for additional requirements.
g. Manufacturers:
    1) ASC Engineered Solutions.
    2) Ductmate Industries, Inc; Clutcher Cable Hanging System.
    3) Duro Dyne.
    4) Gripple.

J. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

K. Tie Rods: Same material as the duct, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 DUCTWORK FABRICATION

A. Fabricate and support duct in accordance with latest edition of SMACNA (DCS).

B. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
2. Fabricate ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

D. Field Painted Ductwork: Provide mill phosphatized finish on exposed surfaces of rectangular ductwork and duct fittings to be field painted.

E. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".
1. Lined Ductwork: Where exterior ductwork is specified on the drawings to be provided with interior lining for thermal or sound performance requirements, seal the longitudinal and transverse joints with sealant rated for exterior exposure.

F. Cross breaking or Cross Beading: Cross break or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.

G. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.

H. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.

I. Provide mitered elbows where space does not permit radius elbows, where shown on the drawings, or at the option of the contractor with the engineer’s approval. The contractor shall obtain approval to substitute mitered elbows in lieu of radius elbows prior to fitting fabrication. Mitered elbows less than 45 degrees shall not require turning vanes. Mitered elbows 45-degrees and greater shall have single thickness turning vanes of same material and gauge as ductwork, rigidly fastened with guide strips in ductwork. Vanes for mitered elbows shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork. Refer to Section “Ductwork Accessories” for turning vane construction and mounting.

J. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

K. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

L. Round and Flat Oval Duct Fabrication
   1. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
      a. Fabricate round and flat oval ductwork of minimum 26 gauge sheet metal.

M. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-1, RL-4, or RL-5 except where diameters exceed 72 inches. Seam Types RL-2 or RL-3 may be used for ducts smaller than 72 inches in diameter if spot-welded on 1-inch intervals. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-5 through 3-13 for galvanized steel gauges. For round duct with static pressure classification of 2 inches water gauge or lower, round supply ducts

may be fabricated using snaplock seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-6A, RL-6B, RL-7 or RL-8.

N. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gauges listed in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-15.

O. Round and Flat Oval Fittings Fabrication
1. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 3-5, 3-6 and 3-7 and with metal thickness specified for longitudinal seam straight duct.
2. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
3. Elbows: Unless elbow construction type is indicated, provide elbows meeting the following requirements:
    a. Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter.
        1) Elbows in Round Duct: Provide full radius elbows.
        2) Elbows in Flat Oval Duct: Provide full radius elbows. Where space limits the installation of full radius elbows, short radius elbows with a minimum of two continuous splitter vanes shall be installed. Vane length shall be the entire length of the bend or 36 inches whichever is greater.
        3) The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
        4) Provide full radius elbows for ductwork installed in noise critical spaces or where shown on the drawings. Refer to Section “Basic Mechanical Materials and Methods” for noise critical spaces.
    b. Mitered Elbows: Fabricate mitered elbows with welded construction in gauges specified below.
        1) Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-1.
        2) Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
            a) 3 to 26 inches: 24 gauge.
            b) 27 to 36 inches: 22 gauge.
            c) 37 to 50 inches: 20 gauge.
            d) 52 to 60 inches: 18 gauge.
            e) 62 to 84 inches: 16 gauge.
        3) Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
            a) 3 to 14 inches: 24 gauge.
            b) 15 to 26 inches: 22 gauge.
            c) 27 to 50 inches: 20 gauge.
            d) 52 to 60 inches: 18 gauge.
            e) 62 to 84 inches: 16 gauge.
        4) Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.

5) 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vane.

c. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.

d. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.

e. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.

f. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.

g. Round Gored Elbows Gauges: Same as for non-elbow fittings specified above.

h. Flat Oval Elbows Gauges: Same as longitudinal seam flat oval duct.

i. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gauge.

4. Double-Wall (Insulated) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.

a. Outer Shell: Base outer shell gauge on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation. Gauges for outer shell shall be same as for uninsulated fittings specified above.

b. Insulation: Unless otherwise indicated, provide 1-inch-thick. 1.5 pounds per cubic foot density fiber-glass insulation with thermal conductivity performance of 0.27 Btu/sq.ft./°F/inch-thickness at 75°F mean temperature. Provide insulation ends where internally insulated duct connects to single-wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.

c. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gauges listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."

d. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gauges listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."

1) 3 to 34 inches: 24 gauge.
2) 35 to 58 inches: 22 gauge.
3) 60 to 88 inches: 20 gauge.

e. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

5. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

a. Round Elbows 4 to 8 Inches: 2-piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.

b. Round Elbows 9 to 26 Inches: Standing seam construction.

c. Round Elbows 28 to 60 Inches: Standard gore construction, riveted and bonded.

d. Other Fittings: Riveted and bonded joints.
e. Couplings: Slip-joint construction with a minimum of a 2-inch insertion length.

P. Shop Application of Liner in Rectangular Ducts
1. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
2. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
3. Butt transverse joints without gaps and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
5. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
a. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
a. Fan discharge.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where duct velocity is greater than 2,500 FPM.
8. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. General: At the Contractor’s option, factory-manufactured ductwork can be provided instead of fabricated ductwork for round and oval ductwork. The round duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer. The oval duct system shall be sealed with duct sealer as specified.
1. Ducts shall be calibrated to manufacturer's published dimensional tolerance standard.
2. All duct 14" diameter and larger shall be corrugated for added strength and rigidity.
3. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.
4. Ducts shall be constructed using spiral lock seam sheet metal construction.
5. Ductwork to be installed in exposed locations shall have the surface prepared in the factory for field painting.

B. Duct Construction

1. Unless otherwise noted, all duct and fittings shall be constructed from galvanized steel in accordance with SMACNA's Duct Construction Standards for +10" water gauge pressure with minimum wall thickness as shown in the following tables.
2. Duct shall be calibrated to manufacturer's published dimensional tolerance standard.
3. Ducts shall be constructed using spiral lock seam sheet metal construction.
4. Ductwork to be installed in exposed locations shall be factory-prepared for field painting, i.e. mill-phosphatized.

Single Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct (ga)	Galvanized Fittings (ga)
3-14	28	24
15-24	26	24
26-42	24	22
42-60	22	20

Double Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct (ga)		Galvanized Fittings (ga)	
	Inner	Outer	Inner	Outer
3-14	28	28	24	24
16-24	26	26	24	24
26-42	24	24	22	22
44-60	22	22	20	20

Oval Duct:

Major Axis (Inches)	Galvanized Spiral Duct (ga)	Galvanized Fittings (ga)
3-24	24	20
25-38	22	20
37-48	22	18
49-60	20	18
61-70	20	16
71 and large	18	16

C. Fittings:
1. All fitting ends for round duct and transitions and divided flow fittings smaller than 24" diameter that convert oval duct to round duct shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to ensure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
2. All fittings shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.
3. All fitting ends from 5" to 60" diameter shall have rolled over edges for added strength and rigidity.

4. All elbows from 5" to 12" diameter shall be 2 piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.
5. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0. The radius of all 15°, 30° and 60° elbows shall be minimum 1.0 times the elbow diameter.
6. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.
7. Double wall duct and fittings shall consist of a perforated or solid inner liner, a 1 inch, 1.50 pounds per cubic foot (unless otherwise specified) layer of fiberglass insulation and a solid outer pressure shell. Perforated inner liner shall have a retaining fabric wrapped between the perforated inner and the fiberglass insulation. This fabric shall provide fiberglass tear retention while maintaining the desired acoustical properties. For 1 inch thick insulation, the outer pressure shell diameter shall be 2 inches larger than the inner liner.
8. All double wall fittings for round duct shall be furnished with the manufacturer's standard gasket on the outer shell. The inner shell on all double wall fittings shall extend a minimum of 1 inch past the outer shell.
9. Double wall to single wall transitions shall be provided where insulated duct connects to non-insulated, single wall duct. Transitions shall also act as insulation ends reducing the double wall outer shell diameter to the inner shell diameter.
10. All double wall duct and fittings shall be furnished with both an inner liner and an outer pressure shell coupling. The inner liners shall not be fastened tighter to allow for expansion and contraction.
11. All volume dampers shall be Lindab Safe type DRU, DSU or DTU or equal by an acceptable manufacturer. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:
    a. Locking quadrant with blade position indicator.
    b. 2" sheet metal insulation stand-off.
    c. Integral shaft/blade assembly.
    d. Shaft mounted, load bearing bushings.
    e. Gasketed shaft penetrations to minimize leakage.

D. Manufacturers:
1. Hercules Industries.
2. Hranec Corporation.
3. Lewis & Lambert.
4. Lindab Safe.
5. Linx Industries, Inc.
6. Semco.

2.05 CONCENTRIC DUCT FOR GREASE EXHAUST

A. General: At Contractors option, in lieu of welded carbon or stainless steel grease exhaust duct, a pre-fabricated concentric duct package may be used subject to local code authority approval. Provide fire rating and clearance to combustibles listing as applicable for the installation.

B. Code Compliance: Material and installation shall comply with UL 1978, UL 2221, ASTM E814, and NFPA 96. Zero clearance applications shall also comply with BOCA ER 96-37 or ICBO ER 5301 Zero Clearance to Combustibles Report.

C. Product Description:
   1. Grease duct shall be factory prefabricated, double wall type, listed for venting of grease laden air from Type 1 kitchen hoods serving commercial cooking appliances.
   2. Material and installation shall be rated for continuous operation at 500 F and intermittent operation at 2000 F.
   3. All grease duct system components shall be by manufacturer to maintain approval agency ratings including supports, guides, fittings, cleanouts, and expansion joints.
   4. Grease duct system shall meet ASTM E119 2-hour fire resistance rating and 3-hour fire engulfment rating and ASTM E814 3-hour Fire Stop Test.
   5. Grease duct system shall be SBCCI tested as an alternate to a 2-hour fire rated shaft and SBCCI classified as a 2-hour fire rated enclosure.
   6. The grease duct system shall be constructed of inner and outer walls with ceramic fiber insulation between the walls.
   7. The inner wall shall be constructed of stainless steel, minimum 0.035 inch thickness.
   8. The inner wall shall be constructed of minimum 18 gauge stainless steel and shall be all welded construction.
   9. The outer wall shall be constructed of aluminized steel or Type 430, Type 304, or 316 stainless steel, minimum 0.024 inch thickness. Provide aluminized steel if duct is exposed and will be field painted.
   10. The insulation shall be minimum 3-inch thickness soluble ceramic fiber.
   11. The grease duct assembly shall be rated for zero clearance to combustibles.

D. Manufacturers:
   1. Ampco.
   2. CaptiveAire
   3. DuraVent Commercial.
   4. Enervex.
   5. Metal-Fab G.
   6. Schebler Chimney Systems.
   7. Security Chimneys.
   8. Selkirk ZeroClear.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products in accordance with manufacturer’s instructions.

C. Install ducts with the fewest possible joints.

D. Seal duct joints with the appropriate sealing material.

E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

J. Install insulated ducts with 1-inch clearance outside of insulation.

K. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

L. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

M. Exposed Ductwork: Exposed ductwork shall be free of defects, dents or blemished surfaces to provide a smooth, finished appearance. Any damaged material shall be replaced with new material. Ductwork that is to be field painted shall have surfaces wiped clean of lubricant, dirt, or fil prior to priming and painting. Apply primer and paint of type as recommended by paint manufacturer for duct material and finish.

N. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

O. Non-Fire-Rated Partition Penetrations: Where ducts pass 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 gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

P. Acoustical Barrier Penetrations: Where a duct passes through a wall, ceiling or floor slab of a noise critical space, provide a clear annular space of 1-inch between the duct and the structure. Refer to Section “Common Work Results for HVAC” for noise critical spaces. The Contractor shall check the clearance and, if clearance is acceptable, shall install the duct and pack the voids full depth with mineral fiber batt insulation. Contractor shall caulk both ends with a non-aging, non-hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material. Where there is insufficient clearance space, Contractor shall place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.

Q. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.

R. Duct Liner Installation
   1. Fiberglass Duct Liner:
      a. Attach fiberglass duct liner using fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
   2. Flexible Elastomeric Duct Liner:

a. Install liner in accordance with the manufacturer's installation instructions or ASTM C 1710.
b. Attach flexible elastomeric duct liner to clean, oil-free sheet metal surfaces with adhesive as recommended by the liner manufacturer.
c. Seal all longitudinal seams and end joints with manufacturer's recommended adhesive and install compression joints in accordance with manufacturer's instructions to eliminate any openings in insulation that would allow passage of air to duct surface being insulated.

3. Polyester Duct Liner:
a. Install polyester duct liner per SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," unless otherwise specified.
b. Attach polyester duct liner using a nonflammable, low VOC water based adhesive.
c. Apply a nonflammable, low VOC water based lagging adhesive to the exposed leading edge of the insulation.
d. Install fasteners per SMACNA HVAC Duct Liner installation instructions.

S. Kitchen Hood Exhaust
1. Provide for thermal expansion of ductwork through 2,000°F temperature range.
2. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.
3. Horizontal Ducts:
a. Provide at least one opening that is minimum size of 20 inches by 20 inches for personnel entry. Where an opening of this size is not possible, provide access openings at each change in direction and at 12-foot intervals. Locate openings on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct. Support systems for ducts 24 inch and larger in any dimension shall be designed for the weight of the duct plus 800 pounds at any point in the duct system.
b. Slope horizontal ductwork serving a Type I hood back toward the hood or local grease reservoir a minimum of 1/4 inch per foot. Horizontal ducts that exceed 75 feet in length shall be sloped not less than 1 inch per foot.
4. Vertical Ducts:
a. For ducts larger than 24 inches by 24 inches, provide a 20 inch by 20 inch access opening for personnel entry at the top of the vertical riser.
b. For ducts smaller than 24 inches by 24 inches, provide an access opening at each floor level in a location that is accessible and not higher than 12 feet above finished floor.
c. Supports for ducts large enough for personnel entry shall be designed for the weight of the duct plus 800 lbs at any point in the duct system.
5. Provide transition at connection to fan with opening size equal to or greater than the venturi opening of the fan inlet. Provide gasket at flanged connection to fan rated for 1500 F and grease applications.
6. Do not penetrate fire-rated assemblies without providing shaft, field-applied or factory-built enclosure.

T. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

U. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

V. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

W. Seam and Joint Sealing
   1. General: Seal duct seams and joints as follows:
      a. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
      b. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized. Transfer air ducts and sound boots do not need to be sealed.
   2. Seal externally insulated ducts prior to insulation installation.
   3. Ductwork installed exterior to the building without weather-proof jacket or cladding shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.
      a. Lined Ductwork: Where exterior ductwork is specified on the drawings to be provided with interior lining for thermal or sound performance requirements, seal the longitudinal and transverse joints with sealant rated for exterior exposure.
   4. Aerosolized Duct Sealing:
      a. Application must be performed by a manufacturer approved service provider and the procedure shall be done as per manufacturer’s recommendations.
      b. Duct Preparation:
         1) Inspect air distribution system for major leakage and repair major leakage greater than ½ inch externally using mastic and tapes per SMACNA standards.
         2) Inspect air distribution system for significant accumulation of dust, dirt and debris and remove all debris and significant dust and dirt by duct cleaning method.
         3) Temporarily remove or protect from aerosol particles building instrumentation and control devices, humidifier dispersion tubes, and fire and smoke sensors. Temporarily isolate air moving equipment and block off air inlets and outlets.
      c. Duct Sealing:
         1) Seal air distribution system from the inside using automated aerosolized sealant injection.
         2) Repair all injection and test holes in existing ductwork sealed tight as per SMACNA standards.

X. Hanging and Supporting
   1. Install rigid round, rectangular, and flat oval metal duct with support systems per SMACNA standards.
   2. The use of wire rope hanging systems is an acceptable alternate hanging method when installed in strict accordance with manufacturer’s instructions. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer’s recommended load rating.
      a. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.

3. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
4. Support vertical ducts at a maximum interval of 16 feet and at each floor.
5. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.
6. Install concrete insert prior to placing concrete.
7. Install powder actuated concrete fasteners after concrete is placed and completely cured.
8. Provide double nuts and lock washers on threaded rod supports.
9. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
10. Refer to Section “Seismic Controls for Mechanical” for seismic bracing requirements.

Y. Penetrations
1. Fire Barrier Penetrations: Where ducts pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity.
2. Exterior Wall Penetrations: Seal duct penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 23 Section “Basic Piping Materials and Methods” for additional information.
3. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Seal ducts that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 23 Section "Basic Piping Materials and Methods” for special sealers and materials.

Z. Connections
1. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."
2. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards”.
3. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards". Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor’s option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."
4. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards”.

3.02 FIELD QUALITY CONTROL

A. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

B. General Duct Systems: Perform leakage tests on the duct systems listed below in accordance with ASHRAE and SMACNA standards.
1. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
2. Conduct tests at static pressures equal to the maximum design pressure of the system or the section being tested. If pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure. Give 7 days' advanced notice for testing. Submit a letter report

to the Owner and Engineer summarizing the test procedures followed, systems tested and the results of the leakage tests.

3. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test section.
4. Maximum Allowable Leakage: As described in ASHRAE 2005 Handbook, "Fundamentals" Volume, Chapter 35, Table 9 and Figure 13. Comply with requirements for leakage classification 3 for round and flat oval ducts, leakage classification 12 for rectangular ducts in pressure classifications less than and equal to 2 inches water gauge (both positive and negative pressures), and leakage classification 6 for pressure classifications greater than 2 inches water gauge and less than and equal to 10 inches water gauge.
5. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.
6. Leakage Test: Perform volumetric measurements and adjust air systems as described in Testing, Adjusting and Balancing chapter of ASHRAE "HVAC Applications" Volume, Duct Design chapter of ASHRAE "Fundamentals" Volume, and Division 23 Section "Testing, Adjusting and Balancing for HVAC."

C. Ductwork with Pressure Rating > 3" W.C.: Ducts and plenums shall be leak tested in accordance with SMACNA HVAC Air Duct Leakage Test Manual to prove they meet leakage classification less than or equal to 6. Submit test reports to the Engineer of Record demonstrating that at least 25 percent of the installed duct area has been tested and pass this test.

D. Grease Duct Leakage Test: Test all portions of grease duct systems including joints and connections to hoods for leakage prior to use or concealment of any portion of the grease duct system. Concealed ducts include any ducts that are installed in shafts or that are covered by coatings or wraps.

1. Perform leakage test using light test in accordance with Chapter 5, Section 506 of the locally adopted IMC or other equivalent test method as approved by the local code official to verify that all joints are liquid tight. Perform tests in the presence of the local code official. Repair and retest any joints found defective until satisfactory results are obtained. Submit a copy of the grease duct leakage test report to the Architect and Engineer complete with the approval signature of the local code official.
2. Perform leakage test using a smoke pressure test using one or more smoke machines to fill the duct with a thick penetrating smoke. Maintain a positive pressure not less than 2 inches w.g. for sufficient time to permit inspection of the grease duct being tested. Perform tests in the presence of the local code official. Repair and retest any joints found defective until satisfactory results are obtained. Submit a copy of the grease duct leakage test report to the Architect and Engineer complete with the approval signature of the local code official.

3.03 ADJUSTING, STARTUP AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "Testing, Adjusting and Balancing for HVAC" for requirements and procedures for adjusting and balancing air systems.

B. Vacuum duct systems prior to final acceptance to remove dust and debris.

C. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.

D. If permanent HVAC equipment is used during the construction period, provide temporary filters at all openings in the ductwork and at inside equipment to protect the system from dust, dirt, paint, and moisture. Replace and maintain filters when needed, but not less than every month. On the day of substantial completion, clean the duct system and provide a new set of filters in the HVAC unit.
   1. Refer to Division 23 Section “Particulate Air Filtration” for filter requirements.

3.04 CLEANING NEW SYSTEMS

A. Contractor shall clean the HVAC systems in accordance with NADCA.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

C. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
      a. Do not degrade structural, thermal or functional system integrity of the duct.
      b. Provide access doors complying with UL 181 to cover new openings. Refer to Division 23 Section “Air Duct Accessories”.
      c. Seal openings with tape and sealant complying with UL 181A.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

D. Vent vacuuming system to the outside. Provide filtration and/or containment systems to keep debris removed from HVAC systems from contaminating other spaces. Locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   4. Coils and related components.
   5. Return air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
   6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.

F. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet.

5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.

H. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and re-inspect ducts.

3.05 CLEANING EXISTING SYSTEMS

A. Contractor shall clean the HVAC systems in accordance with NADCA.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
   a. Do not degrade structural, thermal or functional system integrity of the duct.
   b. Provide access doors complying with UL 181 to cover new openings. Refer to Division 23 Section “Air Duct Accessories”.
   c. Seal openings with tape and sealant complying with UL 181A.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

D. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for wash down procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents, Design Polymer DP 2545, Foster 40-20 or approved equal, if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.

H. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and re-inspect ducts.

I. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

J. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 233113

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Backdraft dampers.

B. Combination fire and smoke dampers.

C. Duct access doors.

D. Duct hardware.

E. Flexible duct connectors.

F. Smoke detectors

G. Volume control dampers.

H. Cable operated damper systems.

I. Fire rated duct wrap.

J. Flexible ductwork.

1.02 SUBMITTALS

A. Product Data: Provide for each type of ductwork accessory the following:
   1. Electrical characteristics.
   2. Connection requirements.
   3. Dimensions.
   4. Capacities.
   5. Pressure drops,
   6. Leakage rates.
   7. Materials of construction.

B. Shop Drawings: Indicate for shop fabricated assemblies the following:
   1. Interfacing requirements with ductwork.
   2. Method of fastening or support.
   3. Methods of assembly of components.

C. Performance Data: Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.

D. Project Record Drawings: Record actual locations of access doors and test holes.

E. 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.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. SMACNA Compliance: Comply with applicable portions of SMACNA (DCS) “HVAC Duct Construction Standards Metal and Flexible”.

C. UL Compliance:
   1. Fire Dampers: Construct, test, and label fire dampers in accordance with current edition of UL Standard 555 Standard for Fire Dampers.
   2. Smoke Dampers: Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S Standard for Smoke Dampers.
   3. Flexible Ductwork: Construct flexible ductwork in compliance with UL Standard 181 Factory-Made Air Ducts and Connections.
   4. Duct Tape: Label in accordance with UL Standard 181B and marked 181B-FX.
   5. Duct Clamps: Label in accordance with UL Standard 181B and marked 181B-C.
   6. Fire Rated Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479 Fire Tests of Through-Penetration Firestops.
   7. Grease Exhaust Duct Wrap: Meet the fire protection requirements defined by UL Standard 1479 Fire Tests of Through-Penetration Firestops.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated

E. NFPA Compliance:
   1. Comply with applicable provisions of 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 pertaining to installation of ductwork accessories.
   2. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations for fire-rated grease exhaust ducts.

F. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 “Standard Test Method for Surface Burning Characteristics of Building Materials” (NFPA 255) method.
   1. Duct silencers shall be tested for performance in accordance with ASTM E477 “Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.”
   2. Grease exhaust duct wrap shall be tested for performance in accordance with ASTM E 2336 “Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems” and ASTM E814 “Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops”.
   3. Fire rated duct wrap shall be tested in accordance with ASTM E814 “Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops”.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect ductwork accessories during shipping and storage from dirt, debris and moisture damage.

B. Protect dampers from damage to operating linkages and blades.

1.05 SPARE PARTS

A. Extra Fusible Links: One link for every 10 installed of each type, size and temperature range. Obtain receipt.

PART 2 PRODUCTS AND MATERIALS

2.01 BACKDRAFT DAMPERS

A. Manufacturers:
   1. Air Balance, Inc.
   2. Arrow United Industries.
   3. Cesco
   4. Greenheck
   5. Louvers & Dampers, Inc.
   6. Nailor Industries, Inc.
   7. Pottorff
   8. Ruskin Mfg. Co.
   9. TAMCO
   10. Vent Products

B. Backdraft Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to open at indicated static pressure. Provide adjustment device to permit setting for varying differential static pressure
   1. Construct frames of minimum16 gauge galvanized steel or 10 gauge aluminum.
   2. Construct blades of minimum 16 gauge aluminum.
   3. Provide minimum 1/2" diameter, corrosion-resistant bearings and 1/2" diameter, galvanized or stainless steel axles.
   4. Mechanically lock blade edge seals into blade edge. Provide neoprene seals for round dampers and silicone or vinyl seals for rectangular dampers.

2.02 DUCT ACCESS DOORS

A. Manufacturers:
   1. Air Balance Inc.
   2. Ductmate Industries.
   3. Duro Dyne Corp.
   4. Greenheck.
   5. Register & Grille Mfg. Co., Inc.
   6. Ruskin Mfg. Co.
   7. Ventifabrics, Inc.
   8. Vent Products.
   9. Zurn Industries, Inc.; Air Systems Div.

B. Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10” by 10” and maximum size of 24” by 24”. Fabricate in accordance with SMACNA (DCS) and as indicated. Label access doors for fire and smoke dampers as specified in Part 3.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. Construct of same or greater gauge as ductwork served. For insulated ductwork. install minimum 1 inch thick insulation with sheet metal cover. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct.
   1. 12 inches square or less: Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors. Provide removable section of duct where duct size is too small for a 10” by 10” access door.
   2. Larger than 12 inches square: Provide two hinges and two handle-type latches.

2.03 DUCT HARDWARE

A. Manufacturers:
   1. Ductmate Industries.
   2. Elgen Manufacturing Co., Inc.
   3. Ventfabrics, Inc.
   4. Young Regulator Co.

B. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated.
   1. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
   2. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

C. 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.

2.04 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:
   1. Carlisle HVAC Products.
   2. Ductmate Industries.
   3. Duro Dyne Corp.
   4. Elgen Manufacturing Co., Inc.
   5. Ventfabrics, Inc.

B. Fabricate in accordance with SMACNA (DCS) and as indicated. Flexible connectors shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

C. Flexible Duct Connections: Fabric crimped into metal edging strip. Provide metal compatible with connected ducts. Factory fabricated. Flame-retardant or noncombustible fabrics compliant with NFPA 701.
   1. Indoor Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric compliant with NFPA 90A.
      a. Minimum Weight: 26 oz./sq. yd.
      b. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
      c. Service Temperature: Minus 40 to plus 200 deg F.
   2. Outdoor Fabric: UL listed fire-retardant woven glass fiber fabric coated with weatherproof, synthetic rubber resistant to UV rays and ozone compliant with NFPA 90A.

a. Minimum Weight: 24 oz./sq. yd.
b. Minimum Tensile Strength: 225 lbf/inch in the warp and 300 lbf/inch in the filling.
c. Service Temperature: Minus 40 to plus 250 deg F.

3. Metal: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of minimum 24 gauge galvanized sheet steel or 0.032-inch- thick aluminum.

D. Maximum Installed Length: 14 inch.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

2.05 SMOKE DETECTORS

A. Manufacturers:
1. Fike.
2. Gamewell-FCI.
3. Kidde/Edwards.
4. Notifier.
5. SimplexGrinnell.
6. Siemens-Cerberus Division.
7. Silent Knight.

B. Duct Smoke Detectors: Photoelectric type complying with UL 268A with a standard, relay or isolator detector mounting base. Provide manufacturer's standard housing to protect the measuring chamber from damage and insects. Provide drilling templates and gaskets to facilitate locating and mounting the housing.
1. Provide for variations in duct air velocity between 100 and 4,000 feet per minute.
2. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet.
3. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
4. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor control circuit.
5. Contacts: Include low voltage supervisory and alarm contacts.
6. Provide remote alarm LEDs and remote test stations as shown on the plans.
7. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.

2.06 VOLUME CONTROL DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. Arrow United Industries
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Rossi Air Flow
9. Ruskin Mfg. Co.
10. TAMCO

11. Vent Products

B. Fabricate dampers in accordance with SMACNA (DCS) and as indicated. Construct using galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.

C. Single Blade Dampers:
1. Fabricate for duct sizes up to 12 x 36 inch.
2. Blade: 20 gauge, 0.04 inch, minimum.

D. Multi-Blade Damper: Fabricate of parallel or opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
1. Blade: 18 gauge, 0.0478 inch, minimum.

E. Bearings: Corrosion resistant, molded synthetic.

F. Axles: Positively lock into the damper blade.

G. Blade Seals: Where used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.

H. Quadrants:.
1. Provide locking, indicating quadrant regulators.
2. On insulated ducts, provide extended shafts and mount regulator on standoff bracket, base or adapter.
3. Where rod lengths exceed 48 inches, provide regulator at both ends.

2.07 CABLE OPERATED DAMPER SYSTEMS

A. Manufacturer:
1. DuroDyne, DuroZone.
2. Metropolitan Air Technology, Inc. (Reference model number for round damper is RT-250 and for rectangular damper is RT-200).
3. Young Regulator Co. (Reference model number is 270).

B. General: Where access to dampers through a hard ceiling is required, provide a concealed, remote cable-operated, butterfly-type volume damper assembly with external worm gear operator.

C. Damper assembly shall include duct casing with rolled bead stiffeners, reinforced blade, self-lubricating bearing, and remote operator mounting plate.

D. Adjustable through the diffuser frame with standard 1/4 inch nut-driver or flat screwdriver.

E. Cable assembly shall attach to damper as a single piece with no linkage adjustment required.

F. Positive, direct, two-way damper control with no sleeves, springs or screw adjustments to come loose after installation.

G. Cable length as required to span the distance from the damper to the remote operator location.

H. Where approved by Architect, a ceiling cup with cover plate can be used for access to cable operator.

2.08 FIRE RATED DUCT WRAP

A. Manufacturers:
1. 3M.
2. Pyroscat
3. Thermal Ceramics
4. Unifrax Corporation

B. Grease Exhaust Ducts:
1. Reference manufacturer and model number is Unifrax FyreWrap Elite 1.5.
2. Minimum two-hour rated duct wrap insulation for Type I hood grease exhaust duct applications.
3. Two layers of 1-1/2 inch thick.
4. Density: Minimum 6 lb. per cubic foot.
5. Zero clearance to combustibles.
6. Flexible wrap enclosure rated for minimum 2000 F.
7. Material: Non-mineral wool, passive, low bio-persistent fiber totally encapsulated with aluminum foil reinforced with scrim. UL Listed in accordance with ASTM E2336.
8. Attachments:
   a. Ducts smaller than 24” by 24” in size, provide stainless steel bands at insulation seams and on maximum 12 inch centers to hold the outer layer of the blanket enclosure in place.
   b. Ducts larger than 24” by 24” in size, provide pins to hold the outer layer in place.
9. Insulation shall be tested for intended use in accordance with all applicable codes and shall be approved by the local code official.
10. Provide factory-built access doors by same manufacturer as fabricated for use specifically with the insulation system.

C. General for HVAC Ducts:
1. Reference Manufacturer and Model Number is Unifrax FyreWrap Elite 1.5.
2. Provide duct wrap insulation for HVAC ducts required to be in rated enclosure construction where dampers are restricted.
3. One, two or three hour-rating as required for the installation.
4. 1-1/2 inch thick wrap.
5. Density: Minimum 6 lb. per cubic foot.
6. Zero clearance to combustibles.
7. Flexible wrap enclosure rated for minimum 2000 F.
8. Applied in one or more layers to achieve the hourly rating requirement.
9. Material: Non-mineral wool, passive, low bio-persistent fiber totally encapsulated on all sides with aluminum foil reinforced with scrim. UL Listed in accordance with ISO 6944 and UL 1479, and as acceptable to the Authority Having Jurisdiction.

D. Access Doors:
1. Manufacturer and/or model number:
   a. Ductmate Ultimate.
   b. FlameGard.
   c. Thermal Ceramics FastDoor XL.
   d. Or Equal.
2. Duct access door to be tested and listed in accordance with UL1978.
3. Gaskets: Liquid tight and minimum 1500F rated.

4. Duct access to be provided with 2-hour and zero clearance insulation cover tested and UL Listed per ASTM E2336 by same manufacturer and as fabricated for use specifically with the insulation system.

2.09 FLEXIBLE DUCTWORK

A. Manufacturers:
   1. ATCO Rubber Products.
   2. Flexmaster.
   3. JPL (J.P. Lamborn Co)
   4. Thermaflex.

B. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regard to required quality of construction and materials.

C. Insulated Flexible Ductwork: Provide duct fabric of ply-vinyl film, polyethylene film or multiple layers of aluminum laminate supported by helically wound spring steel wire. Wrap fabric with fiberglass insulation and provide fire retardant polyethylene or reinforced metalized protective vapor barrier as specified herein.
   1. Duct pressure class up to and including 6” w.g.
      a. Fire retardant polyethylene vapor barrier
         1) ATCO 80 Series
         2) Flexmaster Type 5B
         3) JPL Type PR Series
         4) Thermaflex Type G-KM
      b. Reinforced metalized vapor barrier
         1) ATCO 30 Series
         2) Flexmaster Type 5M
         3) JPL Type MHP Series
         4) Thermaflex Type M-KE
   2. High pressure (duct pressure class over 6” w.g.)
      a. Fire retardant polyethylene vapor barrier
         1) Flexmaster Type 3B
      b. Reinforced metalized vapor barrier
         1) ATCO OmniAir 1200
         2) JPL Type FHP-25
         3) Flexmaster Type 3M
         4) Thermaflex Type M-KC
   3. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
   4. Provide acoustical, fiberglass insulated duct with minimum R-value of R-8.0.

2.10 FLEXIBLE ELBOW ASSEMBLY

A. Manufacturers:
   1. Build Right Products, FlexRight Elbow.
   2. Flexible Technologies, Inc,, FlexFlow Elbow.
   3. Titus, FlexRight.

B. General: At Contractors option, in lieu of rigid sheet metal elbows at connections to air inlets and outlets in concealed spaces, provide flexible elbow assembly to air devices requiring a 90 degree elbow connection.

C. Flexible elbow assembly shall be constructed of durable composite material and UL listed for use in return air plenums with a turning radius of not less than 3 inches.

PART 3 EXECUTION

3.01 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.

3.02 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 backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

C. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

1. Provide duct access doors in ductwork at the following locations
   a. At each change in direction and at maximum 50-foot (15-m) spacing.
2. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1” lettering) indicating which damper type is served. Door shall be capable of being fully opened or provide removable door.

DUCT ACCESS DOOR SCHEDULE

Duct Width/Depth	Door Size	Quantity
10” TO 12”	10 X 10	1
14” TO 18”	12 X 12	1
20” TO 36”	14 X 14	1
38” TO 54”	18 X 18	1
56” TO 72”	18 X 18	2 (1 EACH END)
74” TO 96”	20 X 20	2 (1 EACH END)

3. As an alternate to duct access door for fire damper access in ducts 12 inch and smaller in each direction, a removable duct section can be provided. The duct section shall be Langdon Inc. “Sure Clamp Access” or approved equal with the following features:
   a. Be removable without use of tools.
   b. Be within 4 inches of the damper sleeve break away connection.,
   c. Be insulated same as connected ductwork.
   d. Have same pressure rating as the duct.

e. Have gaskets at seams to seal the connections.

4. Provide duct access doors for cleaning kitchen exhaust ducts in accordance with NFPA 96. Review locations prior to fabrication.

D. Provide flexible duct connections wherever ductwork connects to vibrating equipment and when transitioning between two different metallic duct materials (e.g., aluminum to galvanized steel). Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

1. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
2. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

E. Smoke Detectors: Provide detectors as shown on drawings.

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke detector spacing.
2. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
3. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
4. Coordinate with Division 26 for power wiring and interlocks.
5. Duct Smoke Detectors: Comply with NFPA 72, and NFPA 90A where adopted by the local AHJ. Install sampling tubes so they extend the full width of the duct. Tubes more than 36 inches long shall be supported at both ends.
   a. Do not install smoke detector in duct smoke detector housing during construction. Install detector only during system testing and prior to system turnover.
   b. Air handling units with smoke detection that serve fan-powered terminal units:
      1) Provide duct detection and shutdown fan-powered terminal units that are less than 2,000 cfm when the respective air handling unit shuts down.
      2) Provide individual duct detection and shutdown for each fan-powered terminal unit exceeding 2,000 cfm.
   c. Provide duct detection and shutdown for air distribution systems exceeding 2,000 cfm.

F. Provide volume control dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual volume control damper and locking quadrant for branch duct connections and take-offs to individual diffusers, registers and grilles.

G. Install constant airflow regulators square and free from racking. Do not compress or stretch damper frame into duct or opening. Handle damper using frame or sleeve.

H. Provide cable operated volume dampers with remote operators where access to dampers through a hard ceiling is required.

1. Support cable assembly to avoid bends and kinks in cable.

I. Install grease exhaust and fire rated duct wrap in accordance with manufacturer’s instructions to provide the fire rating of the material as tested per UL requirements. Joints at insulation seams, banding, pins, and fire stop systems shall be installed as per manufacturers UL Listing and manufacturers published installation instructions. Overlap seams, install stainless steel bands

and/or pins to secure wrap to duct and fill annular spaces in floor and wall penetrations with UL rated forming materials and/or putty to maintain the integrity of the system.

J. Install flexible ductwork in accordance with manufacturer's instructions. At a minimum, install two wraps of duct tape around the inner core connection and a metallic or non-metallic clamp over the tape and two wraps of duct tape or a clamp over the outer jacket.
   1. Flexible ductwork runs shall not exceed 5 feet in length. Utilize the minimum length of duct to make the connections.
   2. Install flexible ductwork straight as possible avoiding tight turns with a maximum of one 90 degree bend in any length. Install flexible ductwork fully extended minimizing compression.
   3. Provide continuous length with no intermediate joints.
   4. Support flexible ductwork from structure and not from ceiling tile, light fixtures or air terminals. Support for maximum sag of 1/2-inch per foot.
   5. Avoid incidental contact with metal fixtures, water lines, pipes, or conduit.
   6. Support straps/saddles shall be minimum 1-1/4" wide. Use of wire hanging systems shall utilize strap and connect wire to strap.
      a. Factory installed suspension systems are acceptable
   7. Do not crimp flexible ductwork against joist or truss members, pipes, conduits, etc.
   8. Install flexible ductwork with bend radius at the center line equal to or greater than one duct diameter.
      a. Support bends approximately one duct diameter on both sides of bends.
   9. Connect flexible ductwork to sheet metal ductwork and air devices with at least 1" overlap.

K. Provide rigid duct elbow or flexible elbow assembly where a 90 degree elbow is required at connection to air devices.

L. Install duct silencers at locations indicated on the drawings with straight sections of upstream and downstream ductwork as recommended by the manufacturer.
   1. If the silencer is installed in a location exposed to water or weather, the fill shall be completely encapsulated in mylar bagging. The mylar bagging shall not degrade the acoustical performance of the silencer.

M. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 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.

B. After start-up, final corrections and balancing of systems, test duct silencers by taking octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed. Refer to Division 23 Section "Testing, Adjusting and Balancing of HVAC" for additional requirements.
   1. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
   2. Submit complete report of test results including sound curves.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".

C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 233300

SECTION 233413
AXIAL HVAC FANS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Destratification fans.

1.02 SUBMITTALS

A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
   1. Materials gages and finishes, including color charts.

C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: One set for each individual fan.

1.03 QUALITY ASSURANCE

A. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.05 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS AND MATERIALS

2.01 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
   1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

2.02 DESTRATIFICATION FANS

A. Manufacturers:
   1. Airius.

B. General Description: Small diameter housed propeller type destratification fans as indicated consisting of housing, fan blades, hub, mounting system, motor, and fan controller.

C. Housing: Fan housing shall be constructed from one of the following materials:
   1. PC/ABS resin, UL 94 5VA flame resistance rating.
   2. Steel with polymeric or corrosion-resistant coating.
   3. Painted aluminum.

D. Housing Configuration:
   1. Pear shaped.

E. Fan Blades: PC/ABS resin or aluminum material with airfoil or axial design.

F. Motor and Frame: Electrically commutated, 92% efficient motor with 0-10 VDC control for tie-in to BAS. Provide thermally protected motor. Operating temperature range shall be -13˚ F (-25˚ C) to 140˚ F (60˚ C). Motor shall have sealed bearings with no lubrication required.

G. Mounting System and Location:
   1. Overhead Structure: Designed for secure mounting of fan from overhead support structure. Mount shall be constructed of minimum 3/16” powder-coated steel. Provide minimum 1/4” 7x19 steel safety cable to secure fan assembly to structure.
   2. Suspended Ceiling: Support fan from above structure with cable or wire capable of supporting 5 times the fan weight.

H. Fan Controller:
   1. Industrial Control Panel constructed per UL 60950 and NEC.
   2. Provide fan on/off/auto switch, speed control potentiometer, safety disconnect and properly sized fuse block.
   3. Provide NEMA Type 1 controls enclosure for indoor installations and NEMA Type 3R controls enclosure for outdoor installations.
   4. Fan controller shall be capable of full integration into the building automation system via Bacnet interface. Refer to the drawings for control sequences.

PART 3 EXECUTION

3.01 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.

B. Coordinate the size and location of structural steel support members.

3.02 INSTALLATION

A. Install fans level and plumb, in accordance with manufacturer's written instructions.

B. Support units using the vibration control devices indicated and specified in Division 23 Section "Vibration Isolation for HVAC Piping and Equipment."

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping blocking and bracing.
   2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.

B. Starting procedures for fans:
   1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

3.05 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:
   1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
   2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233413

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SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Roof ventilators.

B. Upblast roof exhausters.

C. Inline centrifugal fans.

D. Kitchen hood exhausters.

1.02 SUBMITTALS

A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
   1. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
   2. Materials gages and finishes, including color charts.
   3. Dampers, including housings, linkages, and operators.

C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

E. Maintenance Data: Include instructions for lubrication, motor and drive replacement and spare parts list.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: One set for each individual fan.

1.03 QUALITY ASSURANCE

A. AMCA Compliance: Provide products that meet AMCA certified performance and sound ratings and are licensed to use the AMCA Seal.

B. UL Compliance: Fans and fan motors shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

C. Kitchen Hood Exhaust Fans: Kitchen hood exhaust fans and components shall comply with requirements of UL 762 “Outline of Investigation for Power Roof Ventilators for Restaurant

Exhaust Appliances and NFPA 96 “Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations”.

D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

F. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.05 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS AND MATERIALS

2.01 POWER VENTILATORS - GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished; with indicated capacities and characteristics.

B. Statically and Dynamically Balanced: Fans and shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
   1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210 “Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating”.

D. Sound Ratings: Comply with AMCA 301 “Certified Ratings Program Product Rating Manual for Fan Sound Performance”. Test fans in accordance with AMCA Standard 300 “Reverberant Room Method for Sound Testing of Fans”.

E. Fabrication: Comply with AMCA 99.

F. Motors: Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.

G. Factory Finish: The following finishes are required:
   1. Sheet Metal Parts: Prime coating prior to final assembly.
   2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.02 ROOF VENTILATORS

A. Manufacturers:
   1. Greasemaster.

B. Fan Unit: Direct-drive as indicated, centrifugal or axial fan, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

D. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports .

E. Fan Wheel: Aluminum hub and wheel.

F. Accessories: Provide the following items as indicated:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
   2. Bird Screens: Maximum 1/2-inch mesh, 16-gage, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.
   4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
      a. Blades: Die-formed sheet aluminum.
      b. Frame: Extruded aluminum, with waterproof, felt blade seals.
      c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
      d. Operators: Manufacturer's standard electric actuator.
      e. Operators: Manufacturer's standard pneumatic actuator.

2.03 UPBLAST ROOF EXHAUSTERS

A. Manufacturers:
   1. Greasemaster

B. General Description: Belt-driven or direct-drive as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Fan Wheel:
   1. Type: Non-overloading centrifugal, propeller or axial blades as scheduled
   2. Material: Aluminum ,

D. Housing:
   1. Construct of heavy-gage aluminum including curb cap, windband and motor compartment..
   2. Rigid internal support structure.
   3. One-piece fabricated or fully welded curb-cap to windband for leak proof construction.
   4. Wind Band and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
      a. Dampers Rods: Steel with bronze or nylon bearings.
   5. Provide breather tube for fresh air motor cooling and wiring.

E. Shafts and Bearings:

1. Fan Shaft:
   a. Ground and polished steel with anti-corrosive coating.
   b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings
   a. Permanently sealed or pillow block type.
   b. Minimum L10 life in excess of 50,000 hours.

F. Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Pulleys: Cast-iron, adjustable-pitch, keyed and securely attached to the wheel and motor shafts..

G. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports.

H. Drain Trough: Provides single point drainage for water or other residue.

I. Accessories: Provide the following items as indicated:
1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Maximum 1/2-inch mesh, 16-gage aluminum or brass wire.
3. Dampers: Counter-balanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
   a. Blades: Die-formed sheet aluminum.
   b. Frame: Extruded aluminum, with waterproof, felt blade bumpers.
   c. Linkage: Nonferrous metals.
   d. Operators: Manufacturer's standard electric actuator.
   e. Operators: Manufacturer's standard pneumatic actuator.

2.04 INLINE CENTRIFUGAL FANS

A. Manufacturers:
1. Greasemaster

B. Fan Unit: Inline, direct driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

C. Housing: Galvanized steel or split, spun-aluminum housing, with straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Wheel: Aluminum, forward curved, backward inclined or airfoil blades welded to aluminum hub.

E. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.

F. Accessories: Provide the following accessories as indicated:
1. Volume Control Damper: Manual operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.

3. Fan Guards: Expanded metal in removable frame.
4. Speed Control: Variable speed switch with on-off control and speed control for 100 to 50 percent of fan air delivery.

2.05 KITCHEN HOOD UPBLAST EXHAUSTERS

A. Manufacturers:
   1. Greasemaster

B. Fan Unit: Direct-drive as indicated, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing:
   1. Construct of heavy-gage, removable, spun-aluminum including curb cap, windband and motor compartment.
   2. Rigid internal support structure.
   3. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
   4. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
   5. Provide breather tube for fresh air motor cooling and wiring.

D. Fan Wheel: Aluminum hub and blades.

E. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least 25 percent over maximum cataloged operating speed.
   2. Bearings
      a. Permanently sealed or pillow block type.
      b. Minimum L10 life in excess of 50,000 hours.

F. Grease Exhaust: Exhaust fans serving Type I kitchen exhaust hoods shall discharge a minimum of 40” above the roof surface, shall have hinged access, shall have access opening on curvature of outer housing for blade inspection and cleaning, and shall be installed in accordance with NFPA 96 and local codes.

G. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports

H. Drain Trough: Grease drain trough shall be filled with replaceable, absorbent material or replaceable cup with absorbent material and cap which absorbs grease and rejects water.

I. Accessories: Provide the following items as indicated:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
   2. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
   3. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
   4. Hinge Kit:
      a. Aluminum hinges.

b. Hinges and restraint cables mounted to base (sleeve).
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.

5. Heat Baffle: Prevents heat from radiating into motor compartment.

PART 3 EXECUTION

3.01 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

3.02 INSTALLATION

A. Install fans level and plumb, in accordance with manufacturer's written instructions.

B. Secure roof-mounted fans to pre-engineered roof equipment supports in accordance with the requirements specified in Section “Hangers and Supports for HVAC Piping and Equipment.”

C. Cabinet Units: Suspend units from structural steel support frame using steel wire or metal straps.

D. Install vibration isolation for equipment as specified in Division 23 Section “Vibration Isolation for HVAC Piping and Equipment.”

E. Arrange installation to provide access space around fans for service and maintenance.

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
1. Remove shipping blocking and bracing.
2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
   a. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Shut unit down and reconnect automatic temperature control operators.
4. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.05 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:
   1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
   2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233423

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SECTION 233433
AIR CURTAINS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Air curtains.

1.02 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit.

B. Shop Drawings: For air curtain units.
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Operation and Maintenance Data: Manufacturer’s printed instructions for operating and maintaining air curtain components.

E. Warranty Documentation: Submit manufacturer’s warranty and ensure that forms have been completed in Owner’s name and registered with manufacturer.

F. Delegated Design Submittal: Signed and sealed by a qualified professional engineer.
   1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Wiring Diagrams: Power, signal, and control wiring.

1.03 COORDINATION DRAWINGS:

A. Submit plans and details drawn to scale and coordinated with penetrations of walls.

1.04 QUALITY ASSURANCE

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

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air curtains and are based on the specific product indicated. Alternate manufacturers shall meet the design intent shown on the drawings. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with AMCA 220, "Test Methods for Air Curtain Units," for airflow, outlet velocity, and power consumption.

E. Comply with AHRI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
   1. Certify coils according to AHRI 410.

F. Comply with NSF 37, "Air Curtains for Entranceways in Food and Food Service Establishments."

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.
   1. Warranty Period (Nonheating Units): Five years.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish one set of filters and fan belts for each unit.

PART 2 PRODUCTS AND MATERIALS

2.01 AIR CURTAINS

A. Manufacturers:
   1. Air curtains in for customer entry doors:
      a. Berner International Corp. model AI08.
      b. Powered Aire, Inc. model CED.
   2. Air curtains in stock and receiving areas:
      a. Mars model STD2.
      b. Powered Aire, Inc, models BCE, ETA, or EVE.

B. Frame: Minimum 16-gauge galvanized steel or aluminized steel base frame with welded construction.

C. Housing Panel and Finish: Provide finish as scheduled on the plans.
   1. Galvanized steel.
   2. Aluminum.
   3. Stainless steel.
   4. Molded, high impact polyethylene.

D. Mounting Brackets: Steel, for mounting as scheduled.

E. Air Adjustment: Provide one of the following options to reduce air volume and outlet velocity to meet the installation requirements:
   1. Multi-speed motors with minimum of 3 speed adjustments.
   2. Intake louvers that are an integral part of the housing, mechanically field adjustable and capable of reducing air-outlet velocity by up to 60 percent.

F. Discharge Nozzle: Integral part of the housing, containing adjustable air-directional vanes with 40-degree sweep front to back.

G. Fans: Galvanized steel, painted steel, or aluminum, centrifugal, forward curved, double width, double inlet; statically and dynamically balanced.
   1. Fan Drives:
      a. Direct drive.
      b. Belt drive, equipped with belt guards and adjustable sheaves and pulleys for adjusting air-outlet velocity.

H. Motors: Comply with Section “Common Motor Requirements for HVAC Equipment”.
   1. Single speed, multispeed or variable speed.
   2. Resiliently mounted, continuous duty.
   3. Totally enclosed, air over.
   4. Explosion proof in hazard locations
   5. Integral thermal-overload protection.
   6. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
   7. Disconnect: Internal power cord with plug and receptacle.

I. Filters
   1. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with glass-fiber media sprayed with nonflammable adhesive in cardboard or galvanized-steel frame.
   2. Washable Panel Filters: Removable, aluminum media, minimum 0.5” thick, aluminum or steel filter frame.
   3. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

J. Accessories: Provide the following accessories where required to meet the specified conditions on the drawings.
   1. Automatic Door Switch: Provide automatic door switch in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
      a. Provide magnetic type at public entrance doors.
   2. Time-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.
   3. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, and terminal strip.
      a. Provide NEMA 250, Type 1 enclosure.
   4. Mounting Brackets: Provide mounting brackets and other mounting accessories as required to permit installation and functioning of air curtain to meet project installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions where air curtains will be installed for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.02 COORDINATION

A. Coordinate layout and installation of air curtains and suspension system components with other construction, including light fixtures, fire-suppression-system components, and partition assemblies.

B. Coordinate installation of wall penetrations and louvers.

3.03 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Install air curtains with clearance for equipment service and maintenance.

C. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.04 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Common Work Results for Electrical."

3.05 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing air curtains completely, perform visual and mechanical check of individual components.
   2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Repair or replace malfunctioning units and retest as specified above.

3.06 ADJUSTING

A. Adjust belt tension.

B. Adjust motor and fan speed to achieve specified airflow.

C. Adjust discharge louver and dampers to regulate airflow.

D. Adjust air-directional vanes.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air curtains on the following:
   1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
   2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233433

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SECTION 233713
DIFFUSERS REGISTERS AND GRILLES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Ceiling air diffusers.

B. Registers and grilles.

1.02 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. Indicate selections on product data.
   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 at specified airflows.

B. 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.

C. 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 Division 1.

D. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

E. Color Samples for Initial Selection: Manufacturer’s color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

1.03 QUALITY ASSURANCE

A. Test and rate air outlets and inlets in accordance with ASHRAE 70 “Method of Testing the Performance of Air Outlets and Inlets”.

B. Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 “Certification, Rating and Test Manual”.

C. Provide air outlets and inlets bearing ADC Certified Rating Seal.

D. Test and rate sound data for air outlets and inlets in accordance with AHRI 885 “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets (with Addendum 1)”.

E. Install air outlets and inlets in accordance with NFPA 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”.

1.04 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

PART 2 PRODUCTS AND MATERIALS

2.01 CEILING AIR DIFFUSERS

A. Manufacturers
   1. Krueger Mfg. Co.
   2. Price Industries, Inc.
   3. Titus HVAC

B. 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 provided with accessories as required for a complete installation.

C. 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.

D. 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.

E. Types: Provide ceiling air diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

2.02 REGISTERS AND GRILLES

A. Manufacturers
   1. Krueger Mfg. Co.
   2. Price Industries, Inc.
   3. Titus HVAC

B. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.

C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

D. Ceiling Compatibility: Provide registers and grilles 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 register and grille.

E. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

F. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.

2.03 LINEAR SLOT DIFFUSERS

A. Manufacturers
1. Carnes Co.
2. Greenheck.
3. Krueger Mfg. Co.
4. Metalaire; Metal Industries, Inc.
5. Nailor Industries, Inc.
6. Price Industries, Inc.
7. Titus HVAC
8. Tuttle & Bailey; Div. of Air Systems Components, Inc.

B. General: Except as otherwise indicated, provide manufacturer's standard linear slot diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.

C. Performance: Provide linear slot 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.

D. Compatibility: Provide linear slot diffusers with border styles that are compatible with adjacent ceiling or wall systems, and that are specifically manufactured to fit into ceiling or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of linear slot diffuser.

E. Linear Slot Diffusers: Slot diffusers shall be standard one-piece lengths up to 6-feet and shall be furnished in multiple sections greater than 6-feet.
1. Provide straight and curved sections as required to accommodate layout shown on the drawings.
2. Multiple sections shall be joined together end-to-end with alignment pins to form a continuous slot appearance. All alignment components shall be provided by the manufacturer.
3. Where specified on the drawings, plenums shall be manufactured by the slot diffuser manufacturer. Plenums shall be internally insulated, by the manufacturer, with minimum ¼” thick, closed-cell insulation. Insulation shall not be made of fibrous material.

F. Types: Provide linear slot diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.

C. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor’s option, a flexible elbow assembly as specified in Division 23 section “Air Duct Accessories”.

D. 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.

E. Linear Slot Diffuser Installation:
   1. For installations in a hard ceiling, install diffuser prior to installation of drywall. Use manufacturer’s hard ceiling clips for mounting to ceiling framing. Screws through face of diffuser are not acceptable.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before beginning air balance.

3.04 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION 233713

SECTION 233723
HVAC GRAVITY VENTILATORS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Goosenecks.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for HVAC gravity ventilators including the following:
   1. Schedule of HVAC gravity ventilators indicating drawing designation, number furnished, model number, size, and accessories furnished.
   2. Data sheet for each type of HVAC gravity ventilator, and accessory furnished; indicating construction, finish, and mounting details.
   3. Performance data for each type of HVAC gravity ventilator furnished, including pressure loss and noise criteria ratings at specified airflows. Indicate selections on data.
   4. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of HVAC gravity ventilator, indicating materials and methods of assembly of components.
   5. 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 Division 1.

B. Coordination Drawings: Roof plans drawn to scale to show locations and coordination of HVAC gravity ventilators with other items installed on roof.

1.03 QUALITY ASSURANCE

A. ASHRAE Compliance: Test and rate HVAC gravity ventilators in accordance with ASHRAE 70 “Method of Testing for Rating the Air Flow Performance of Outlets and Inlets”.

B. AMCA Compliance: Performance ratings and factory testing of gravity ventilators to be in accordance with AMCA 511 “Certified Ratings Program for Air Control Devices” and AMCA 550 “Test Method for High Velocity Wind riven Rain Resistant Louvers”.

C. NFPA Compliance: Install HVAC gravity ventilators in accordance with NFPA 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”.

PART 2 PRODUCTS AND MATERIALS

2.01 GOOSENECKS

A. Construction: Factory- or shop-fabricate according to SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible”, Figure 5-5 with minimum 0.052-inch thick galvanized steel sheet.

B. Roof Curb: Provide prefabricated, heavy-gage, galvanized steel roof curb with mitered and welded corners; 1-1/2-inch-thick, 3 pound density, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch treated wood nailer.
   1. Overall Roof Curb Height: Minimum 12 inches for roofs with no insulation, 15” for roofs with insulation or as scheduled on the drawings.

C. Screening: Provide aluminum, 1/2-inch square mesh bird screen.

D. Paint Finish:
   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils. Color and gloss as selected by Architect.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which HVAC gravity ventilators are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install HVAC gravity ventilators in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, to interface installation of HVAC gravity ventilators with other work.

C. Locate HVAC gravity ventilators and goosenecks as indicated on the drawings. Adjust location to suit structural conditions.

3.03 CLEANING

A. After installation of HVAC gravity ventilators, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any HVAC gravity ventilator that has damaged finishes.

END OF SECTION 233723

SECTION 233813
COMMERCIAL KITCHEN HOODS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Hood materials.

B. General hood fabrication.

C. Type I hood fabrication.

D. Hood fire suppression system.

1.02 DEFINITIONS

A. Listed Hood: A hood tested according to UL 710 by a testing agency acceptable to authorities having jurisdiction.

B. Standard Hood: A hood that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

D. Type II Hood: A hood designed for heat and steam removal and other non-grease applications.

1.03 SUBMITTALS

A. Product Data: Submit product data including materials of construction, thickness of materials, finishes and performance data.
   1. Hoods.
   2. Grease removal devices.
   3. Fire-suppression systems.
   4. Lighting fixtures.

B. Shop Drawings:
   1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
   2. Indicate performance, exhaust and makeup air airflow and pressure loss, at actual Project-site elevation.
   3. Indicate method of attaching hangers to building structure.
   4. Show exhaust and makeup air duct connections and fittings.
   5. Show water-supply and drain piping connections.
   6. Show control cabinets.
   7. Show fire-protection piping, actuation devices, and manual control devices.
   8. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   9. Design Calculations: Calculate requirements for selecting seismic restraints.

10. Wiring Diagrams: Power, signal, and control wiring.

C. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
1. Relative location of ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings to hoods and accessory equipment.
2. Roof framing and support members for duct penetrations.
3. Ceiling suspension assembly members.
4. Size and location of initial access panels for acoustical tile.

E. Welding certificates.

F. Field test reports.

1.04 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; and AWS D9.1, "Sheet Metal Welding Code," for joint and seam welding.

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. NSF Compliance: Fabricate hoods according to NSF 2, "Food Equipment."

D. SMACNA Compliance:
1. Fabricate hoods to comply with SMACNA's "HVAC Duct Construction Standards: Metal and Flexible," second edition.

E. UL Compliance:
1. Listed and labeled according to UL 710 by a testing agency acceptable to authorities having jurisdiction.
2. Meet applicable UL listing for components and installation as specified herein.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of food service equipment installation areas by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 COORDINATION

A. Coordinate equipment layout and installation with other Work, including light fixtures, HVAC equipment, and fire-suppression system components.

1.07 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. Furnish one complete set of grease removal devices.

PART 2 PRODUCTS AND MATERIALS

2.01 HOOD MANUFACTURERS

A. Greasemaster

2.02 HOOD MATERIALS

A. Stainless-Steel Sheet: ASTM A666, Type 430. Provide Type 304 for corrosive environments.
   1. Minimum Thickness: 0.036 inch.
   2. General: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
   3. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
   4. Exposed Surfaces: ASTMA 480/A480M, No. 4 finish (bright, directional polish).

B. Carbon-Steel Sheets: ASTM A366/A366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

C. Zinc-Coated Steel Shapes: ASTM A36/A36M, zinc coated according to ASTM A123/A123M requirements.

D. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.
   1. Color: As selected by Architect from manufacturer's full range.
   2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

E. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.

F. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and passes testing according to UL 710.

2.03 HOOD FABRICATION, GENERAL

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
   1. Welded Butt Joints: Make full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with hood material without relying on straps under seams, filling in with solder, or spot welding.

2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.

B. For metal butt joints, comply with SMACNA's "Kitchen Equipment Fabrication Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.

J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Equipment Fabrication Guidelines."

K. Fabricate enclosure panels to ceiling and wall as follows:
1. Fabricate panels on all exposed sides with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of 3 inches.
3. Wall Shelves and Over-shelves: Fabricate according to SMACNA's "Kitchen Equipment Fabrication Guidelines," with minimum 0.0625-inch thick, stainless-steel shelf tops.

2.04 TYPE I HOOD FABRICATION

A. Weld joints exposed to grease with continuous welds.

B. Make grease removal devices and makeup air diffusers easily accessible for cleaning.

C. Exhaust-Duct Collars: Minimum 0.0625-inch- thick stainless steel at least 3 inches long, continuously welded to top of hood and at corners.[Fabricate a collar with a 0.5-inch- wide duct flange.

D. Hood Configuration: Provide exhaust only or exhaust and makeup air configuration as shown on the drawings. Introduce makeup air using the following configurations as indicated on the drawings.

1. Induction or combination of induction and diffusion inside canopy. If makeup air is not heated, insulate interior of makeup air plenum with high-density insulation having maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
2. Through front, bottom or front and bottom of canopy using supply-air registers.
3. Through laminar-flow-type perforated metal panels on front of hood canopy.
4. Through plenum at rear of hood extending down below appliance cooking surfaces.

E. Hood Style: Provide the following hood style where indicated on the drawings.
1. Wall-mounted canopy.
2. Single-island canopy.
3. Double-island canopy.
4. Back shelf.
5. Eyebrow.
6. .Pass over.

F. Grease Removal Filters/Baffles:
1. Provide removable, stainless-steel, filter/baffle grease filters.
2. Provide spring-loaded fastening where required by the authority having jurisdiction.
3. Fabricate with minimum 0.0781-inch- thick stainless steel for filter frame and removable collection cup and trough.
4. Install filters at an angle not less than 45 degrees from horizontal.
5. Pitch exposed surfaces including drain trough to drain to collection cup.
6. Comply with UL 1046, "Grease Filters for Exhaust Ducts."

G. Removable Grease Extractor:
1. Removable, stainless-steel extractor, at least 0.0781 inch thick.
2. Test hood with extractor according to UL 710.

H. Stationary Water-Wash Grease Extractor:
1. Integral, automatically self-cleaning, spraying hot water and detergent over the entire length of exhaust plenum.
2. Fabricate to supply a minimum of 140 deg F water at 1 gpm per foot of hood length, at 40- to 60-psig inlet pressure.
3. Water Piping: ASTM A270, Type 304 stainless steel with "R" surface finish.
4. Fabricate to drain water and detergent to a collection trough having stainless-steel drain fittings.
5. Provide single, hood or wall-mounting control panel with a solid-state, programmable controller to control all hoods on Project. Factory set the wash cycle to operate for 10 minutes after fans stop.
    a. Supply detergent by an adjustable-flow, 120-V ac injection pump from a reservoir with a minimum capacity of 2.5 gal.

I. Water Mist Option:
1. Supply a maximum of 1 gpm per foot of hood length through stainless-steel piping and nozzles.
2. Water Piping: ASTM A270, Type 304 stainless steel with "R" surface finish.

J. Light Fixtures: UL-listed, recessed or surface-mounted, LED or incandescent fixtures and lamps with lenses sealed vapor tight. Install wiring in stainless-steel conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc on cooking surface below hood.

1. Mount switches on front panel of hood canopy, on wall adjacent to hood or in hood control panel.
2. LED Lighting Fixtures: Comply with UL 8750.
3. Incandescent Lighting Fixtures: Comply with UL 1571.

K. Hood Controls: Single, hood or wall-mounting control cabinet shall control groups of adjacent hoods and shall be fabricated of stainless steel. Provide the following control where indicated on the drawings.
1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously during normal hood operation. Interlock exhaust fan with fire-suppression system to operate exhaust fans during fire-suppression-agent release and to remain in operation until manually stopped. Motor starters shall comply with Division 26 Section "Enclosed Controllers."
2. Photocell and Temperature Modulating Control: Vary speed of exhaust and makeup air fans with variable frequency controllers, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between minimum and maximum values allowed by the local authorities having jurisdiction. Controller shall limit supply air quantity to ensure proper operation of makeup air unit.
3. Photocell and Temperature Staged Control: Stage exhaust and makeup air fans on and off, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between minimum and maximum values allowed by the local authorities having jurisdiction. Controller shall limit supply air quantity to ensure proper operation of makeup air unit.
4. High-Temperature Control: Sound alarm and shut cooking equipment down before hood discharge temperature rises to actuation temperature of fire-suppression system.
5. Water-Wash Timer: Provide programmable timer to control sequential wash of multiple hood sections.
6. Water Mist: Solenoid valve interlocked with exhaust fan to open with hood operation.
7. Unoccupied Hood Monitoring: Provide a control signal to the BAS to monitor the hood exhaust fan and makeup air unit operation to ensure they are off during unoccupied periods.

2.05 HOOD FIRE-SUPPRESSION SYSTEM

A. Manufacturers:
1. Ansul Incorporated.
2. Captive-Aire Systems.

B. General:
1. Pre-engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator.
2. Listed and labeled by a testing agency acceptable to authorities having jurisdiction.
3. Factory install, piping, fusible links and release mechanism, tank containing the suppression agent, and integral controls.

C. Piping: Exposed piping shall be chrome plated or stainless-steel sleeves.
   1. Steel Pipe, NPS 2 inch and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.
   2. Stainless Steel: ASTM A312, Type 304 or 316. Schedule 10S pipe or ASTM A269 stainless steel tubing.
   3. Copper: ASTM B88, Type M or L tubing.

D. Pipe Fittings
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300. Exposed fittings shall be chrome plated.
   2. Stainless Steel: ASTM A351, standard pattern threaded or ASTM A403 wrought for welded.
   3. Copper: Wrought copper, streamlined pattern, ASME B16.18 or B16.22 for soldered or ASME B16.50 for brazed.

E. Pipe Covers: Chrome-plated aluminum tubing.

F. Distribution Nozzles:
   1. Locate nozzles to protect the exhaust ducts, plenums and cooking appliances.
   2. Equip the nozzles with a metal blow off cap.
   3. Stamp the nozzle to identify the nozzle type.

G. Liquid Extinguishing Agent: Noncorrosive, nontoxic, low-pH liquid.

H. Controls: Provide controls in stainless-steel control cabinet mounted on hood or wall.
   1. Provide manual activation capability using manual pull station.
   2. Provide automatic activation using electronic or fusible sensing devices.
   3. Furnish an electric-operated, gas shutoff valve with clearly marked open and closed indicator for field installation.
   4. Furnish manual pull station for wall mounting adjacent to hood.
   5. Integrate fire-suppression system controls with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.

I. Electrical
   1. Provide color-coded wiring, numbered terminal blocks and grounding bar.
   2. Provide spare terminals for fire alarm, optional wiring to start fan with fire alarm, and red pilot light to indicate fan operation.
   3. Provide control switches factory wired in control cabinet with relays or starters.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, grease removal devices, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.

B. Remove tool and die marks and stretch lines or blend into finish. 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. Install hoods level and plumb.

D. Complete field assembly of hoods where required.
   1. Make closed butt and contact joints that do not require filler.
   2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication" Article.

E. Make cutouts in hoods where required to run service lines and to make final connections.

F. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.

G. Install hoods to operate free from vibration.

H. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.

I. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

J. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to hoods with clearance to allow service and maintenance.

C. Duct Connections: Comply with applicable requirements in Division 23 Section "Air Duct Accessories" for flexible connectors on makeup air supply duct. Weld exhaust-duct connections.

D. Fire-Suppression Piping: Install piping connections for remote-mounted suppression systems according to NFPA 17, "Wet Chemical Extinguishing Systems."

E. Ground equipment.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

B. Testing: See Division 23 Section, "Testing, Adjusting and Balancing for HVAC."
   1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Test motors and rotating equipment for proper rotation and lubricate moving parts according to manufacturer's written instructions.
   4. Test piping and water, drain, and gas components for leaks. Repair or replace leaking components.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.05 ADJUSTING

A. Set initial temperatures, and calibrate sensors.

B. Set field-adjustable switches.

3.06 CLEANING

A. Remove protective coverings and clean and sanitize hoods and associated services, both inside and out, according to manufacturer's written instructions.

B. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

C. When polishing is complete on stainless steel materials, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

3.07 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
   1. Overview of the system and/or equipment as it relates to the facility as a whole.
   2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
   3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 233813

SECTION 235100
BREECHINGS CHIMNEYS AND STACKS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Pre-manufactured breechings and chimneys.

B. Plastic gas vents.

C. Guying and bracing.

1.02 DEFINITIONS

A. Breeching: The conduit conveying flue gas from the appliance to the chimney.

B. Chimney: A structure containing one or more vertical or nearly vertical passageways for conveying flue gases to the outside atmosphere.

C. Stack: A primarily vertical, round, vent.

D. Vent: A flue-gas conveying system intended for use with certain gas-, liquid-, or solid fuel-fired appliances that do not produce flue gas outlet temperatures higher than a value specified in the listing vent standards.

E. Category I Appliance: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

F. Category II Appliances: An appliance that operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

G. Category III Appliances: An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

H. Category IV Appliances: An appliance that operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

1.03 SUBMITTALS

A. Product Data: Submit product data including materials, dimensions, weights, required clearances, and accessories.

B. Shop Drawings:
   1. Indicate general construction, dimensions, weights, support, and layout of breeching, chimneys, and stacks.
   2. Submit layout drawings indicating plan view, elevations, and details.
   3. Submit detail assemblies and indicate method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

C. Manufacturer's Instructions: Include installation instructions and indicated assembly, support details, and connection requirements.

D. Manufacturer's Certificates: Submit certificates of compliance with specified reference standards.

E. Welders Certificates: Include welder certification of compliance with ASME BPVC-IX.

F. Wind and Seismic Certificates: Submit complete engineering report certifying that stacks meet the design wind and seismic loads.

1.04 QUALITY ASSURANCE

A. Comply with the following Codes and Standards:
   1. NFPA 211 "Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances."
   2. NFPA 54 "National Fuel Gas Code" for natural gas and propane burning appliances.
   3. NFPA 31 "Standard for the Installation of Oil-Burning Equipment" for fuel oil appliances.
   4. NFPA 37 "Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines" for generator engines.
   5. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.
   6. SMACNA: Comply with SMACNA's "HVAC Duct Construction Standards" for fabricated breeching and smokepipe and with SMACNA's "Guide for Steel Stack Design and Construction" for steel stacks.
   7. AWS: All welders and procedures shall be certified in accordance with AWS D1.1, "Structural Welding Code-Steel," for hangers and supports and in accordance with AWS Standard D9.1, "Sheet Metal Welding Code" for duct joining and seam welding.
   8. ASHRAE: Comply with the ASHRAE Systems and Equipment Handbook for Chimney, Gas Vent, and Fireplace Systems material requirements and design criteria.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle breeching and stack components carefully to prevent damage, denting and scoring. Do not install damaged components; replace with new.

PART 2 PRODUCTS AND MATERIALS

2.01 PRE-MANUFACTURED BREECHINGS AND CHIMNEYS

A. Manufacturers:
   1. AMPCO.
   2. DuraVent Commercial.
   3. Enervex Inc.
   4. Hart & Cooley, Inc.
   5. Metal-Fab, Inc.
   6. Schebler Chimney Systems.
   7. Security Chimneys.
   8. Selkirk Metalbestos.

9. Van-Packer Co.

B. General: Factory-built, double-wall metal vent system using modular connectors and manifolds, tested according to UL 103 and rated for rated up to 60 inches w.c. positive or negative pressure complying with NFPA 211. System shall be designed to compensate for flue gas induced thermal expansion.

C. Factory-Built, Residential-Type and Building Heating Appliance-Type Chimney:
1. Rated for 1000 degrees F continuous flue temperature, and up to 1700 degrees F for 10 minutes.
2. Construction: Separate inner shell and outer jacket with an annular space filled with high-temperature, ceramic-fiber insulation. Minimum separation:
   a. 2-inch.
3. Inner Shell: Type 304, 316, or AL29-4C stainless steel.
4. Outer Jacket: Galvanized, aluminized, or stainless steel.

D. Accessories, UL labeled:
1. Provide tees, adjustable lengths, elbows, increasers, draft hood connectors, terminations, dampers, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners, fabricated from similar materials and designs as vent-pipe straight sections, all listed for same assembly. Provide discharge assembly termination compatible with manufacturer system to protect against and/or drain rainfall.
2. Protect aluminized steel surfaces exposed to the elements with a minimum of one base coat of primer and one finish coat of corrosion resistant pain, suitable for outer jacket skin temperatures of the application and jacket material.

2.02 PLASTIC GAS VENTS

A. General: UL 1738 listed, with positive or negative flue pressures complying with NFPA 211 and suitable for condensing gas appliances.

B. PVC:
1. Materials: Schedule 80 PVC plastic pipe, rated for maximum flue gas temperature of 149 degrees F continuously, complying with ASTM D1784, cell class 12454 or 23447.
2. Fittings: Same material and thickness as the piping, furnished by the same manufacturer as the piping.
3. Joining Materials: PVC solvent cement, furnished by the same manufacturer as the piping, comply with ASTM D2564.
4. Manufacturers:
   a. IPEX System 1738.
   b. Approved equal.

C. Polypropylene:
1. Materials: Minimum 2.2 mm thick polypropylene, rated for 230 degrees F continuously.
2. Fittings: Same material and thickness as the piping.
3. Joining Materials: EPDM or Viton gaskets with stainless steel locking clamp.
4. Manufacturers:
   a. Centrotherm Innoflue Single Wall.
   b. Nova-Flex Group Z-DENS.
   c. Approved equal.

D. Accessories, UL labeled: Provide tees, adjustable and variable lengths, elbows, increasers, draft hood connectors, terminations, dampers, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners, fabricated from similar materials and designs as vent pipe straight sections, all listed for same assembly. Provide discharge assembly termination compatible with manufacturer system to protect against and/or drain rainfall.

E. Appliance Adapter: Provide appliance adapter to connect special gas vent to flue outlet of appliance and secure with hose clamp.

2.03 GUYING AND BRACING

A. Cable: Galvanized, stranded wire of the following thickness:
1. Minimum Size: 1/4 inch in diameter
2. For ID Sizes 4 to 15 inches: 5/16 inch in diameter.
3. For ID Sizes 18 to 24 inches: 3/8 inch in diameter.
4. For ID Sizes 27 to 30 inches: 7/16 inch in diameter.
5. For ID Sizes 33 to 36 inches: 1/2 inch in diameter.
6. For ID Sizes 39 to 48 inches: 9/16 inch in diameter.
7. For ID Sizes 51 to 60 inches: 5/8 inch in diameter.

B. Pipe: 1-1/4 inch diameter, galvanized steel.

C. Angle Iron: Galvanized steel 2 by 2 by 1/4 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATION SCHEDULE

A. Category I Appliances:
1. Field fabricated breechings and chimneys.
2. Pre-manufactured breechings and chimneys, Residential and Building Heating Appliance-Type Chimney.
3. Type B double wall gas vents.
4. Refractory lined metal breechings and chimneys.

B. Category II Appliances:
1. Special gas vents, single wall for appliances with flue gases up to 480 degrees F continuously, double wall for flue gases up to 550 degrees F continuously.
2. Plastic gas vents, material type selected to exceed maximum flue gas temperatures of the equipment.

C. Category III Appliances:
1. Special gas vents, single wall for appliances with flue gases up to 480 degrees F continuously, double wall for flue gases up to 550 degrees F continuously.

D. Category IV Appliances:
   1. Special gas vents, single wall for appliances with flue gases up to 480 degrees F continuously, double wall for flue gases up to 550 degrees F continuously.
   2. Plastic gas vents, material type selected to exceed maximum flue gas temperatures of the equipment.

E. Solid-Fuel Appliances:
   1. Field fabricated breechings and chimneys.
   2. Pre-manufactured breechings and chimneys, Type HT Chimney.
   3. Refractory lined metal breechings and chimneys.

F. Generator Engine:
   1. Pre-manufactured breechings and chimneys, 1400 F Type Chimney.
   2. Refractory lined metal breechings and chimneys.
   3. Generator engine field fabricated exhaust piping

G. Combination combustion air and flue gas vent: Double wall special gas vent.

3.03 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

B. Maintain minimum clearances from combustibles specified in third party listing.

C. Align connections accurately with internal surfaces smooth.

D. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.

E. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size. Reference Division 23 Section “Hangers and Supports for HVAC” for supports.

F. Insulation Shields: Where vents pass through insulated assemblies, provide an insulation shiled constructed of steel of minimum 26 gauge thickness with clearance per vent manufacturer’s instructions.
   1. Where vents pass through an insulated attic space, the shield shall terminate a minimum of 2 inches above the insulation.
   2. Where insulation shields are provided as part of a listed vent system, install the shield per the manufacturer’s instructions.

G. Install guy wires and/or braces where maximum unsupported lengths of stacks are exceeded.

H. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

I. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack, minimum 1/4 inch per foot or per manufacturer’s recommendations, whichever is more stringent. Provide flat bottom transitions where required to maintain continuous slope. Provide condensate drain connection at low points with 3/4" plenum rated drain tubing with pigtail trap sized for system

pressure. Pipe drain line to nearest open site drain and terminate with air gap. Provide pH neutralizer in drain line in accessible location.

J. All connections to common breechings shall be 45 degree lateral tees.

K. Install firestopping to preserve fire resistance rating of partitions and other elements.

L. Coordinate installation of dampers and draft control devices. Locate dampers as close to draft hood collar as possible.

M. Install slip joints permitting removal of appliance without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

3.04 INSTALLATION OF PLASTIC GAS VENTS

A. Coordinate vent material compatibility with the appliance manufacturer's installation instructions prior to installation.

B. Where plastic gas vents are installed in a return air plenum, wrap the vent with fire rated plenum insulation.
   1. Refer to Division 23 Section "Common Work Results for HVAC" for plenum-rated fire wrap.

3.05 FIELD QUALITY CONTROL

A. Temporary Closure: At ends of breechings and chimneys that are not completed or connected to equipment, provide temporary closure that will prevent entrance of dust and debris until installations are completed.

B. Touch-up or refinish sections or accessories that are scratched or marred during shipping and handling, or require touch-up after welding.

3.06 ADJUSTING AND CLEANING

A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

END OF SECTION 235100

SECTION 235500
FUEL FIRED HEATERS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Gas-fired unit heaters.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer’s literature including weights, dimensions, metal gages, and data on features and components. Include plan and elevation views of units, data on ratings and capacities and installation instructions.

B. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

C. Wiring Diagrams: Include electrical power and control wiring for heaters. Include ladder-type wiring diagrams for interlock and control wiring required for field installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

D. Operation and Maintenance Data: Include manufacturer’s literature, operating instructions, maintenance data and parts listing for inclusion in "Operating and Maintenance Manual" specified in Division 1.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. AGA Approval: Design certified and labeled by the American Gas Association.

C. NFPA Compliance:
   1. NFPA 70, "National Electrical Code."
   2. NFPA 31, "Standard for Installation of Oil-Burning Equipment."
   3. NFPA 54, "National Fuel Gas Code."

D. NRTL Approval: Heaters bear the label of a National Recognized Testing Laboratory (NRTL) that meets the requirements defined in OSHA Regulation 1910.7.

PART 2 PRODUCTS AND MATERIALS

2.01 FUEL-FIRED HEATERS, GENERAL

A. Types, Minimum Ratings, Locations, and Mountings: As indicated on the drawings.
   1. Gas-Fired Heaters and Accessory Items:
      a. Comply with NFPA 54.
      b. AGA Approval.

c. Type of Gas: Heaters designed and built to burn natural gas or propane as scheduled on the drawings with characteristics the same as those of the gas available at the Project site.

2. Oil-Fired Heaters and Accessory Items:
   a. Comply with NFPA 31.
   b. NRTL Approval.

B. Assembly and Wiring: Factory assembled, piped, wired, and tested.

C. Heater Electrical Rating: 115 V a.c. except as otherwise indicated.

D. Propeller Fans: Factory-balanced, resilient-mounted, with aluminum blades and 100-percent steel blade guard.

E. Centrifugal Fans: Factory-balanced, resilient-mounted, steel, belt driven with adjustable-pitch motor sheave except as otherwise indicated.

F. Motors: Totally enclosed with internal thermal overload protection and complying with Division 23 Section "Common Motor Requirements for HVAC Equipment," except as otherwise indicated.
   1. Heater Motors: Energy efficient types as defined in Division 23 section "Common Motor Requirements for HVAC Equipment."

G. Concentric Terminal Vent Assembly: Combined combustion air inlet and power vent outlet. Include adapter assembly for connection to inlet and outlet pipes, and flanges for wall penetration.

H. Control Transformer: Integrally mounted. 120 V a.c./24 V a.c.

2.02 GAS-FIRED UNIT HEATERS

A. Manufacturers:
   1. Detroit Radiant.
   2. Hastings HVAC.
   3. Lennox Industries, Inc.
   4. Modine Mfg. Co.
   5. Reznor.
   6. Sterling Heating Equipment Div.

B. General: Comply with ANSI Z83.8, "Gas Unit Heaters."

C. Housing: Steel with baked enamel or powder coating over external surfaces, with integral motorized vent exhauster and inserts for suspension mounting rods.

D. Ignition: Electronically controlled spark with flame sensor.

E. Burners: Cast iron or aluminized steel.

F. Automatic Fan Thermal Switch: Delays fan start until discharge air is heated. Delays fan shutdown until air cools to comfort threshold.

G. Heat Exchanger: Aluminized or stainless steel as scheduled.

H. Unit Fan Type: Propeller or centrifugal as scheduled.

I. Automatic Gas Control: Single or two stage, 24 V a.c. valve as required to meet sequence of operation.

J. Separated Combustion Air Supply: Combustion and heat exchange chambers isolated from heated space atmosphere.

K. Discharge Louvers: Provide one of the following options for each heater as required to serve the installed space or where indicated on the drawings.
   1. Independently adjustable horizontal blades.

L. Burner Safety Controls:
   1. Thermocouple sensor to prevent opening gas valve until pilot flame is proven and stop flow on ignition failure.
   2. Flame rollout switch to prevent operation when no flame.
   3. Vent flow verification using flame rollout switch or differential pressure switch.
   4. High limit thermal switch or fuse.

2.03 TEMPERATURE CONTROL

A. Refer to Division 26 for power wiring and cables .

B. Refer to Division 23 Section “Direct Digital Control for HVAC” for control wiring and cables.

C. Refer to Division 23 Section “Instrumentation and Control Devices for HVAC” for control sensors and components.

D. Thermostats: Provide one of the following thermostats for the fuel fired heaters as indicated on the drawings and as required to meet the specified sequence of operation.
   1. Single-stage, 24-V a.c. type with duct-mounting sensor and a 50 F - 90 F operating range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which heaters and components are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Verify that rough-in for fuel piping is sized and located to meet the heater and component piping connections.

C. Verify that the rough-in for combustion air and vent connections are sized and located to meet the heater connections.

3.02 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Install gas-fired heaters and associated fuel and vent features and systems in accordance with NFPA 54, applicable local codes and regulations, and manufacturer's printed installation instructions.

1. Install plastic piping used for vents that is approved by the manufacturer and rated for the application in accordance with Division 23 Section "Basic Piping Materials and Methods." Install guards designed to prevent entrance of birds, insects, and dirt.

C. Install oil-fired heaters and associated fuel and vent piping in accordance with NFPA 31, applicable local codes and regulations, and manufacturer's printed installation instructions.

D. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.
1. Spring hangers are specified in Division 23 section "Vibration Isolation for HVAC Piping and Equipment."

E. Substrate Mounted Units: Provide supports connected to substrate. Secure units to supports.

F. Power Wiring: Refer to Division 26 for installation of power conduit, wiring and components.

G. Install controls as specified in Division 23 Section ”Instrumentation and Control Devices for HVAC”.

H. Identify heaters and connections in accordance with Division 23 section "Identification for HVAC Piping and Equipment."

3.03 CONNECTIONS

A. Connect gas piping to heaters according to requirements of Division 22 Section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service.

B. Connect oil piping in accordance with Division 23 Section "Facility Fuel Oil Piping."

C. Connect vents in accordance with Division 23 Section "Breechings, Chimneys and Stacks."

D. Connect condensate drain pans using Type M copper tubing with streamline drainage fittings and soldered joints. Extend to nearest equipment drain or floor drain. Construct vented, deep trap at connection to drain pan and install cleanouts at changes in direction. Terminate to suit local code requirements, except where stricter methods are indicated.

E. Connect ducts in accordance with Division 23 section "Metal Ductwork."

3.04 STARTUP

A. Test functions, operations, and control sequences and protective features. Adjust to assure operation is in accordance with design.

B. Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.05 CLEANING AND ADJUSTING

A. Cleaning: Upon completion of installation, inspect heaters and associated components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

B. Adjusting: Make burner and other unit adjustments for optimum heating performance and efficiency. Adjust heat distribution features, including louvers, vanes, shutters, dampers, and reflectors, to provide optimum heat distribution for objects, personnel, and spaces served.

3.06 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
   1. Overview of the system and/or equipment as it relates to the facility as a whole.
   2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
   3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 235500

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SECTION 237200
AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Heat wheels.

B. Packaged energy recovery units.

1.02 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Shop Drawings:
1. Include plans, elevations, sections, details, and attachments to other Work.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

D. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

E. Warranty: Submit manufacturer's warranty and ensure forms are completed in Owner's name and registered with manufacturer.

F. Field quality-control test reports.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

D. AHRI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with AHRI 1060 “Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment”.

E. ASHRAE Compliance: Capacity ratings for energy recovery devices shall comply with ASHRAE 84 “Method of Testing Air-to-Air Heat Exchangers”.

F. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

1.04 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 23 Section “Common Work Results for HVAC”.

1.05 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: Furnish one set of each type of filter specified.
   2. Wheel Belts: Furnish set of belts for each heat wheel.

PART 2 PRODUCTS AND MATERIALS

2.01 HEAT WHEELS

A. Manufacturers:
   1. Airxchange
   2. Aldes North America.
   3. FlaktGroup SEMCO.
   4. Heatex, Inc.
   5. Novel Aire Technologies
   6. Thermotech Enterprises, Inc.
   7. Xetex

B. Cabinet: Galvanized steel with manufacturer's standard paint coating. Include the following:
   1. Internally insulated.
   2. Casing seals on periphery of rotor, and on duct divider, with 1-inch duct flanges for connection of supply and exhaust ducts.
   3. Support removable rotor on grease-lubricated ball bearings with extended grease fittings, or permanently lubricated ball bearings. Mount horizontal wheels on tapered roller bearing.

C. Wheel: Provide enthalpy type for both sensible and latent heat recovery designed to ensure laminar flow.
   1. Construct wheel media of corrugated aluminum, glass-fiber or polymer material , with nontoxic, noncorrosive silica-gel or molecular sieve desiccant coating permanently bonded to the media.

2. Provide wheel structure of stainless steel framework for supporting segments that are removable for servicing,
3. Construct media for passing maximum 800 micrometer solids and maximum 0.04 percent cross contamination by volume of exhaust air.
4. Energy recovery device shall transfer moisture entirely in the vapor phase, so unit shall not require a condensation pan. Drive rotor with belt around outside of rotor.

D. Drive: Fractional horsepower motor and gear reducer.
1. Provide adjustable variable-frequency controller for speed adjustment where scheduled. .

E. Frost Protection: Provide heat or wheel speed control to eliminate frost accumulation where scheduled.

F. Controls:
1. For constant speed wheel, provide starting relay, factory mounted and wired, and manual motor starter for field wiring.
2. For variable speed wheel, provide control panel factory mounted and wired to motor, with airstream thermostat and adjustable variable-frequency controller for field wiring; with pilot-light indication of rotor rotation and provisions for setting maximum and minimum speed.

G. Rotation Detection: Provide electronic control module, electromagnetic sensor, and iron shuttle factory wired and mounted, with alarm bell for field wiring and mounting.

2.02 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturers:
1. Greenheck.

B. Housing: Manufacturer's standard double wall construction with minimum 18 gauge exterior and 20 gauge interior, corrosion-protection coating and exterior finish, gasketed and caulked weathertight, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1 inch, 3 pound thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs. No insulation shall be exposed to the airstream.
1. Inlet: Weatherproof hood or louver, with gravity back draft damper for exhaust and spring-return, two-position, motor-operated damper with blade seals for supply.

C. Energy Recovery Device:
1. Heat wheel.

D. Supply and Exhaust Fans: Provide forward-curved, backward-inclined or airfoil centrifugal fan with internal vibration isolation.
1. Fan Drives: Direct driven or belt driven with adjustable sheaves, motor mounted on adjustable base. Provide adjustable belt drives for 10 hp and smaller and fixed for 15 hp and larger. All belt drives shall be minimum 2 – 5 with 2 bolts and minimum 1.2 service factor.
2. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

E. Filters: Provide disposable type filters as scheduled, in galvanized steel frame, mounted upstream of unit in both supply and exhaust airstreams.

F. Piping: Fabricate units with space within housing for piping.

G. Electrical: Provide control panel to house starters, contactors or variable frequency drives as required for each motor to meet the sequence of operation specified on the drawings.
   1. Factory install power and control wiring to motors and unit components to enable a single point power connection. Wire motors and controls so only external connections are required during installation.
   2. Provide control power transformer.
   3. Provide UL listed control panel with hinged access door and interlocking disconnect switch, NEMA 12 rated for indoor units and NEMA 3R rated for outdoor units.
   4. Provide motors with over-current, overload and motor starting functions.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.
   1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
   2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
   3. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."

C. Install fixed media devices so supply and exhaust airstreams flow in opposite directions.
   1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to media. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."

D. Secure roof-mounted units to roof equipment supports. Refer to the drawings for the type of support required for each roof mounted unit.
   1. Refer to Division 23 Section “Hangers and Supports for HVAC Piping and Equipment” for standard roof curbs.
   2. Refer to Division 23 Section “Vibration Isolation For HVAC” for vibration isolation curbs.

E. Support suspended units from structure; use threaded steel rods.

F. Install units with clearances for service and maintenance.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.02 CONNECTIONS

A. Duct and fan installation requirements are specified in other Division 23 sections. Drawings indicate general arrangement of ducts, fittings, and specialties. Provide flexible duct connectors where ducts are connected to units with fans.

B. Ground equipment according to Division 26.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Adjust seals and purge.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Set initial temperature and humidity set points.
   5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

3.05 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
   1. Overview of the system and/or equipment as it relates to the facility as a whole.
   2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
   3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 237200

SECTION 237413
OUTDOOR PKGD HEATING AND COOLINGS UNITS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Packaged roof top unit.

B. Unit Controls.

C. Roof mounting curb and base.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, and furnished specialties and accessories. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

C. Shop Drawings:
1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components
2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.

D. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling 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.

E. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

F. Operation and Maintenance Data: Submit maintenance data and parts list for each rooftop unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Codes and Standards:
   1. Gas-fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
   2. AHRI Compliance:
      a. Testing and rating of rooftop units of 65,000 Btu/hr capacity or over shall be in accordance with AHRI 340/360 “Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment”.
      b. Testing and rating of rooftop units under 65,000 Btu/hr capacity shall be in accordance with AHRI 210/240 “Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment”.
      c. Capacity ratings for air-to-air energy recovery equipment shall comply with AHRI 1060 “Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment”.
      d. Capacity ratings for water coils shall comply with AHRI 410 “Forced-Circulation Air- Cooling and Air-Heating Coils”.
      e. Sound testing and rating of units shall be in accordance with AHRI 270” Sound Performance Rating of Outdoor Unitary Equipment”. Units shall bear Certified Rating Seal.
   3. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 “Safety Code for Mechanical Refrigeration”.
   4. Rooftop units shall be listed by UL and have UL label as a unit. Comply with UL 1995 “Heating and Cooling Equipment”.

1.04 FLAMMABLE REFRIGERANTS

A. Equipment with refrigeration systems using Group A2L refrigerants shall meet all requirements of ASHRAE Std 15 and this section.

B. Listing and Installation Requirements:
   1. Listed in accordance with UL 484 or UL 60335-2-40/CSA C22.2 No. 60335-2-40.
   2. The nameplate shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing.
   3. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.

C. Refrigeration systems shall have an integral refrigerant detection system that meets the following requirements as documented in ASHRAE Std 15:
   1. Utilize a set point, nonadjustable in the field, to generate an output signal to initiate mitigation actions.
   2. Field recalibration of refrigerant detection system shall not be permitted.
   3. Be capable of detecting the presence of a specified refrigerant corresponding to the refrigerant designation of the refrigerant contained in the refrigeration system.
   4. Have access for replacement of refrigerant detection system components.
   5. Have self-diagnostics to determine operational status of the sensing element.
   6. Energize air circulation fans of the equipment upon failure of a self-diagnostic check.
   7. Generate an output signal in not more than 30 seconds when exposed to a refrigerant concentration of 25% LFL (+0%, -1%).

D. Manufacturer's refrigeration mitigation action shall be completed in not more than 15 seconds after the initiation of the output signal of the equipment's integral refrigerant detection system and shall be maintained for at least 5 minutes after the output signal has reset.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept products, with factory-installed shipping skids and lifting lugs. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units. Inspect for damage.

B. Protect units from physical damage by storing off site or in locked, protected area until roof mounting curbs are in place, ready for immediate installation of units.

1.06 SPECIAL WARRANTY

A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
   1. Warranty Period: 5 years from date of substantial completion.

1.07 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit.
   1. One set of matched fan belts for each belt driven fan.
   2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
   3. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS:

A. Primary Manufacturer: Subject to compliance with requirements, provide rooftop units of one of the following:
   1. Lennox Industries, Inc.

B. Approved Equals: Equals shall only be provided when primary manufacturer has lead times outside of the acceptable delivery date and as approved by Sprouts.
   1. Greasemaster.

2.02 MANUFACTURED UNITS

A. General: Roof or slab mounted units, factory assembled, prewired and tested,

B. Description: Self-contained, packaged unit consisting of compressors, condensers, evaporator coils, heating system, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics shall be as scheduled on the Drawings.

C. Refrigerant: Provide rooftop units designed to operate with refrigerant as scheduled on the drawings.

2.03 FABRICATION

A. Cabinet: Provide manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs.
   1. Bottom Duct Connections: Provide steel or aluminum walking grate on structural supports where connections are located in sections accessible by personnel for maintenance.

B. Insulation: Minimum of 1" thick, 1.5 pound density thermal insulation.

C. Condensate Drain Pan: Provide galvanized or stainless steel condensate drain pan sloped to drain connection.

D. Filters Section: Provide filter housing of material matching the unit casing with gasketed filter media holding frames. Provide access panel large enough for filter replacement with continuous gasketing and positive locking devices.

E. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports and Section “Vibration Isolation for HVAC Piping and Equipment” for vibration isolated equipment support bases.

2.04 FANS

A. Supply Fans: Provide forward-curved or backward inclined, centrifugal fan wheel, V-belt drive with adjustable variable pitch motor pulley or direct drive, rubber isolated hinge mounted high efficiency motor and permanently lubricated motor bearings.

B. Condenser Fans: Provide propeller-type, direct-driven fans, resiliently mounted with fan guard, with permanently lubricated bearings.

2.05 MOTORS:

A. Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.

2.06 AIR FILTRATION

A. Final Filters Section: Provide 2" thick fiberglass throwaway pleated filters in filter rack, with maximum face velocity of 400 fpm and minimum MERV rating per ASHRAE 52.2 of MERV 13.

2.07 GAS-FIRED HEAT EXCHANGERS:

A. Provide aluminized steel construction for gas-fired heat exchangers and burners with entering air temperatures higher than 50 F. Provide stainless steel construction for gas-fired heat exchangers and burners with entering air temperatures less than or equal to 50 F or have airstreams that are corrosive. Provide heat exchangers and burners designed for staged or modulating operation as scheduled or noted on the drawings with minimum efficiency of 80 percent. Provide single gas connection.

B. Gas Burner: Atmospheric or power-vented type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.

C. Operating Controls: Provide the following controls for the gas-fired heat exchangers:
1. Intermittent pilot ignition;
2. Electronic spark ignition system;
3. High limit cutout;
4. Forced draft proving switch;
5. Flame roll-out switch.

2.08 ELECTRIC HEAT SECTIONS:

A. Provide manufacturer's standard construction electric heat coils, factory-wired for single point wiring connection, complete with control circuit transformer and fuse, airflow proving device, over-current and over-heat protection devices.

B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.09 EVAPORATOR COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant.

C. Provide interlaced coils in multiple stage units to ensure full coverage over coil face.

D. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of refrigerant.

E. Provide corrosion protective coating where scheduled.

F. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.

2.10 HOT GAS REHEAT COIL:

A. Provide hot gas reheat coil with staged or modulating control for reheat during dehumidification operation. Size hot gas reheat coil capacity to maintain space temperature when unit is operating in the dehumidification mode with no load in the space. Refer to control drawings.

2.11 COMPRESSORS:

A. Provide serviceable, semi-hermetic, or fully hermetic compressors, complete with integral vibration isolators, crankcase heaters which de-energize during compressor operation.

B. Accessories: Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors.

2.12 CONDENSER COIL

A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.

B. Provide corrosion protective coating where scheduled.

C. Provide refrigerant pressure switches to cycle condenser fans

2.13 MIXED AIR CASING

A. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section “Instrumentation and Control Devices for HVAC.”

B. Outdoor Air Damper:
1. Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
2. Refer to schedules and control diagrams on the drawings for quantity, capacity and control method of the outdoor air dampers of each unit.

C. Economizer Control:
1. Provide economizer system complete with return and outside air dampers, outside air filter, fully modulating electric control system with dry bulb or enthalpy control as noted on the drawings, and adjustable mixed-air thermostat.
2. System shall have 100 percent outside air capability.
3. Provide automatic changeover through adjustable control device.

D. Relief Damper: Provide a relief damper with control type as scheduled on the drawings.

2.14 OPERATING CONTROLS:

A. Provide solid-state control board and components that contain at a minimum the following features in addition to control features specified in the contract documents:
   1. Indoor fan on/off delay.
   2. Default control to ensure proper operation after power interruption.
   3. Service relay output.
   4. Unit diagnostics and diagnostic code storage.
   5. Field-adjustable control parameters.
   6. Fan-proving switch to lock out unit if fan fails.

B. DDC Interface: Install stand-alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 section "Direct Digital Control for HVAC".

C. Thermostat: Programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:
   1. Touch sensitive keyboard.
   2. Automatic switching.
   3. Degree F readout.
   4. LED indicators.
   5. Hour/day programming.
   6. Manual override capability.
   7. Time and operational mode readout.
   8. Status indicator.
   9. Battery backup.
   10. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

2.15 SAFETY CONTROLS:

A. Provide safety controls for the following:
   1. Low pressure cutout, manual reset type;
   2. High pressure cutout, manual reset type;
   3. Compressor motor overload protection, manual reset type;
   4. Anti-recycling timing device;
   5. Adjustable low-ambient lockout;
   6. Oil pressure switch.

2.16 ELECTRICAL

A. Provide a 125 VAC, 20 amp duplex convenience receptacle mounted to unit ready for field wiring through the curb with a cover UL listed for wet and damp locations when in use.

B. Unit power connection shall be either through unit cabinet or within roof curb perimeter.

C. Rooftop units shall be designed to meet the minimum short-circuit withstand rating specified on the drawings.

2.17 ACCESSORIES

A. Units shall include the following accessories where scheduled or shown on the drawings:
   1. Remote Control Panel: Furnish panel for remote mounting containing control of heating, cooling, evaporator fan, and outdoor damper; and indicator lights for up to 6 unit functions.
   2. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.
   3. Low ambient control head pressure control, designed to operate at temperatures down to temperature specified on the drawings.
   4. Provide guards to protect the condenser coil from hail or other damage.
   5. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard subbase.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions under which rooftop units are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. For roof installed units, verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

D. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF ROOFTOP HEATING AND COOLING UNITS

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Secure roof-mounted units to roof equipment supports and grade-mounted units to curbs or base. Refer to the drawings for the type of support required for each rooftop unit.
   1. Refer to Section “Hangers and Supports for HVAC Piping and Equipment” for standard roof curbs.
   2. Refer to Section “Vibration Isolation For HVAC” for vibration isolation curbs.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
   1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

D. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.

E. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties.

F. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

G. Connect gas piping to gas-fired heat exchanger according to requirements of Division 22 section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service.

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust fan for required airflow in accordance with Section “Testing, Adjusting and Balancing for HVAC.” Tighten belts as required for proper operation.

B. Adjust damper linkages for proper damper operation.

C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
1. Remove shipping, blocking, and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters. Do not operate air handling unit without pre-filters installed.
9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
10. Disable automatic temperature control operators.

B. Start-Up Services: Provide the services of a factory-authorized service representative to start-up rooftop units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    a. Replace fan and motor pulleys as required to achieve design conditions.
    b. Measure and record motor electrical values for voltage and amperage.
    c. Shut unit down and reconnect automatic temperature control operators.

d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.05 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 237413

SECTION 237433
DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Package rooftop mounted units capable of supplying 100 percent outdoor air.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, and furnished specialties and accessories. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

C. Shop Drawings:
   1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components
   2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.

D. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for dedicated outdoor air heating and cooling 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.

E. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

F. Operation and Maintenance Data: Submit maintenance data and parts list for each dedicated outdoor air unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Codes and Standards:
   1. Gas-fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
   2. AHRI Compliance:

a. Testing and rating of dedicated outdoor air units capacity shall be in accordance with AHRI 920 “Performance Rating of DX Dedicated Outdoor Air System Units”.
b. Capacity ratings for air-to-air energy recovery equipment shall comply with AHRI 1060 “Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment”.
c. Capacity ratings for water coils shall comply with AHRI 410 “Forced-Circulation Air- Cooling and Air-Heating Coils”.
d. Sound testing and rating of units shall be in accordance with AHRI 270 “Sound Performance Rating of Outdoor Unitary Equipment”. Units shall bear Certified Rating Seal.

3. Refrigerating system construction of dedicated outdoor air units shall be in accordance with ASHRAE 15 “Safety Code for Mechanical Refrigeration”.
4. Integrated Seasonal Moisture Removal Efficiency (ISMRE) and Integrated Seasonal Coefficient of Performance (ISCOP) of dedicated outdoor air units shall be equal to or greater than prescribed by ASHRAE 90.1 “Energy Standard For Buildings Except Low-Rise Residential Buildings”.
5. Dedicated outdoor air units shall be listed by UL and have UL label as a unit. Comply with UL 1995 “Heating and Cooling Equipment”.
6. Dedicated outdoor air units shall be designed, manufactured, and tested in accordance with UL requirements.

1.04 FLAMMABLE REFRIGERANTS

A. Equipment with refrigeration systems using Group A2L refrigerants shall meet all requirements of ASHRAE Std 15 and this section.

B. Listing and Installation Requirements:
1. Listed in accordance with UL 484 or UL 60335-2-40/CSA C22.2 No. 60335-2-40.
2. The nameplate shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing.
3. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.

C. Refrigeration systems shall have an integral refrigerant detection system that meets the following requirements as documented in ASHRAE Std 15:
1. Utilize a set point, nonadjustable in the field, to generate an output signal to initiate mitigation actions.
2. Field recalibration of refrigerant detection system shall not be permitted.
3. Be capable of detecting the presence of a specified refrigerant corresponding to the refrigerant designation of the refrigerant contained in the refrigeration system.
4. Have access for replacement of refrigerant detection system components.
5. Have self-diagnostics to determine operational status of the sensing element.
6. Energize air circulation fans of the equipment upon failure of a self-diagnostic check.
7. Generate an output signal in not more than 30 seconds when exposed to a refrigerant concentration of 25% LFL (+0%, -1%).

D. Manufacturer’s refrigeration mitigation action shall be completed in not more than 15 seconds after the initiation of the output signal of the equipment’s integral refrigerant detection system and shall be maintained for at least 5 minutes after the output signal has reset.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept products, with factory-installed shipping skids and lifting lugs. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units. Inspect for damage.

B. Protect units from physical damage by storing off site or in locked, protected area until roof mounting curbs are in place, ready for immediate installation of units.

1.06 SPECIAL WARRANTY

A. Warranty on Compressor and Gas Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and gas heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
   1. Warranty Period: 5 years from date of substantial completion.

1.07 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts for each dedicated outdoor air unit.
   1. One set of matched fan belts for each belt driven fan.
   2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
   3. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

PART 2 PRODUCTS AND MATERIALS

2.01 PACKAGED ROOFTOP UNITS

A. Manufacturers
   1. Primary Manufacturer: Subject to compliance with requirements, provide rooftop units of one of the following:
      a. Addison.
   2. Approved Equals: Equals shall only be provided when primary manufacturer has lead times outside of the acceptable delivery date and as approved by Sprouts:
      a. Valent Air Management Systems.

B. Manufactured Units
   1. General: Roof or slab mounted units, factory assembled, prewired and tested,

2. Description: Self-contained, packaged unit consisting of compressors, condensers, evaporator coils, heating system, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics shall be as scheduled on the Drawings.
3. Refrigerant: Provide dedicated outdoor air units designed to operate with refrigerant as scheduled on the drawings.

C. Fabrication
1. Cabinet: Provide manufacturer's standard double wall casing construction with fiberglass or foam-injected insulation that provides a minimum R-6 R value. Incorporate a thermal break such that there is no through metal path between the interior and exterior surface of the unit casing at all panel frames, joining mullions, or corners. Provide corrosion protection coating and exterior finish that meets ASTM B117 salt spray test of minimum 500 hours. Provide removable panels or access doors for inspection and access to internal parts, knockouts for electrical and piping connections, an exterior condensate drain connection and lifting lugs.
   a. Bottom Duct Connections: Provide steel or aluminum walking grate on structural supports where connections are located in sections accessible by personnel for maintenance.
2. Condensate Drain Pan: Provide galvanized or stainless steel condensate drain pan sloped to drain connection.
3. Filters Section: Provide filter housing of material matching the unit casing with gasketed filter media holding frames. Size housing to accommodate the filters scheduled on the drawings. Provide access panel(s) large enough for filter replacement with continuous gasketing and positive locking devices.
4. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports and Section “Vibration Isolation for HVAC Piping and Equipment” for vibration isolated equipment support bases.

D. Fans
1. Supply Fans:
   a. Provide forward-curved or backward inclined, centrifugal fan wheel, V-belt drive with adjustable variable pitch motor pulley or direct drive, rubber isolated hinge mounted high efficiency motor and permanently lubricated motor bearings.
   b. Provide plenum fan with airfoil blade wheel with heavy gauge spun aluminum inlet cone.
2. Condenser Fans: Provide propeller-type, direct-driven fans, resiliently mounted with fan guard, with permanently lubricated bearings.

E. Motors:
1. Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.

F. Air Filtration
1. Filters Section: Provide fiberglass throwaway pleated filters in filter rack, with maximum face velocity of 400 fpm. Provide filters of thickness and minimum MERV rating per ASHRAE 52.2as scheduled on the drawings.

G. Gas-Fired Heat Exchangers:
1. Provide aluminized steel construction for gas-fired heat exchangers and burners with entering air temperatures higher than 50 F. Provide stainless steel construction for gas-

fired heat exchangers and burners with entering air temperatures less than or equal to 50 F or have airstreams that are corrosive. Provide heat exchangers and burners designed for staged or modulating operation as scheduled or noted on the drawings with minimum efficiency of 80 percent. Provide single gas connection.

2. Gas Burner: Atmospheric or power-vented type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.
3. Operating Controls: Provide the following controls for the gas-fired heat exchangers:
    a. Intermittent pilot ignition;
    b. Electronic spark ignition system;
    c. High limit cutout;
    d. Forced draft proving switch;
    e. Flame roll-out switch.

H. Electric Heat Sections:
1. Provide manufacturer's standard construction electric heat coils, factory-wired for single point wiring connection, complete with control circuit transformer and fuse, airflow proving device, over-current and over-heat protection devices.
2. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

I. Evaporator DX Coils
1. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
2. Provide equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant.
3. Provide interlaced coils in multiple stage units to ensure full coverage over coil face.
4. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of refrigerant.
5. Provide corrosion protective coating where scheduled.
6. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.

J. Hot Gas DX Reheat Coils:
1. Provide hot gas reheat coil with staged or modulating control for reheat during dehumidification operation. Size hot gas reheat coil capacity to maintain supply air temperature when unit is operating in the dehumidification mode. Refer to control drawings.

K. Compressors
1. Provide serviceable, semi-hermetic, or fully hermetic compressors, complete with integral vibration isolators and crankcase heaters which de-energize during compressor operation.
2. Units shall have the following capacity control measures to prevent excessive compressor short cycling and prevent evaporator coil from freezing:
    a. Digital scroll compressor as the first stage.
3. Heat Pump Units: Provide reversing valve with a replaceable magnetic coil, suction line accumulator, flow control check valve, and solid state defrost control utilizing thermistors. Refrigerant system shall have a pump-down cycle.

4. Accessories: Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors.

L. Condenser Coils
1. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
2. Provide corrosion protective coating where scheduled.
3. Provide refrigerant pressure switches to cycle condenser fans,

M. Air Connections
1. Dampers: Dampers and their operators shall comply with performance requirements specified in Division 23 Section “Instrumentation and Control Devices for HVAC.”
2. Supply Air: Provide flanged connection with gasket to minimize air leakage.
3. Outdoor Air: Provide intake hood or louver designed to inhibit wind-driven rain and snow from entering unit.
    a. Provide complete with birdscreen, 1/2” mesh aluminum or stainless steel.
    b. Dampers: Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
4. Return Air: Provide return air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.

N. Operating Controls:
1. Provide solid-state control board and components that contain at a minimum the following features:
    a. Supply fan on/off delay.
    b. Default control to ensure proper operation after power interruption.
    c. Service relay output.
    d. Unit diagnostics and diagnostic code storage.
    e. Field-adjustable control parameters.
    f. Minimum run time.
    g. Fan-proving switch to lock out unit if fan fails.
2. DDC Interface: Install stand-alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 section "Direct Digital Control for HVAC."

O. Safety Controls: Provide manual reset type safety controls for:
1. Low pressure cutout;
2. High pressure cutout;
3. Compressor motor overload protection.
4. Anti-recycling timing device;
5. Adjustable low-ambient lockout;
6. Oil pressure switch.

P. Electrical:
1. Provide a 125 VAC, 20 amp duplex convenience receptacle mounted to unit ready for field wiring through the curb with a cover UL listed for wet and damp locations when in use.
2. Unit power connection shall be either through unit cabinet or within roof curb perimeter.

3. Dedicated outdoor air units shall be designed to meet a minimum short-circuit withstand rating as specified on the drawings.

Q. Accessories: Units shall include the following accessories where scheduled or shown on the drawings:
1. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.
2. Provide guards to protect the condenser coil from hail or other damage.
3. Provide smoke detector factory installed in supply air.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions under which dedicated outdoor air units are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of units.

B. Examine roughing-in for dedicated outdoor air units to verify actual locations of piping and duct connections before equipment installation.

C. For roof installed units, verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

D. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF DEDICATED OUTDOOR AIR UNITS

A. General: Install dedicated outdoor air units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Secure roof-mounted units to roof equipment supports and grade-mounted units to curbs or base. Refer to the drawings for the type of support required for each dedicated outdoor air unit.
1. Refer to Section “Hangers and Supports for HVAC Piping and Equipment” for standard roof curbs.
2. Refer to Section “Vibration Isolation For HVAC” for vibration isolation curbs.

C. Support suspended units from structural steel support frame using threaded steel rods and spring hangers. Comply with Division 23 section “Vibration Isolation For HVAC Piping and Equipment”.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

E. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.

F. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties.
   1. Condensate Drain Piping: Route condensate drain to nearest roof drain or to location shown on the drawings. Provide trap at connection to drain pan with depth as noted on the drawings and install cleanouts at changes in direction (refer to manufacturer's recommendations for any additional requirements). Size condensate drain piping in accordance with local code and as shown on the drawings.

G. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

H. Connect gas piping to gas-fired heat exchanger according to requirements of Division 22 section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust fan for required airflow in accordance with Section "Testing, Adjusting and Balancing for HVAC." Tighten belts as required for proper operation.

B. Adjust damper linkages for proper damper operation.

C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping, blocking, and bracing.
   2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
   5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   6. Comb coil fins for parallel orientation.
   7. Install clean filters. Do not operate air handling unit without pre-filters installed.
   8. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
   9. Disable automatic temperature control operators.

B. Start-Up Services: Provide the services of a factory-authorized service representative to start-up dedicated outdoor air units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    a. Replace fan and motor pulleys as required to achieve design conditions.
    b. Measure and record motor electrical values for voltage and amperage.
    c. Shut unit down and reconnect automatic temperature control operators.
    d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.05 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
    1. Overview of the system and/or equipment as it relates to the facility as a whole.
    2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
    3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 237433

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SECTION 238126
SPLIT SYSTEM AIR CONDITIONERS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

B. Indoor evaporator fan coil units.

C. Outdoor condenser units.

1.02 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, type of refrigerant used, refrigerant pipe sizing, and electrical characteristics. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Shop Drawings: Provide drawings that indicate size, profile, dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

C. Design Data: Indicate refrigerant pipe sizing.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

F. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, start-up and operating instructions, maintenance and repair data, parts lists, controls, accessories, and trouble-shooting guide.
   1. Include manufacturer’s recommended maintenance schedule of units installed in a seacoast application, within 5 miles of the coast.

H. Warranties: Submit manufacturer’s warranty and ensure forms have been filled out in Owner's name and registered with manufacturer including special warranties specified in this Section.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Fabricate and label refrigeration system to comply with ASHRAE 15 “Safety Standard for Refrigeration Systems”.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “National Electric Code”, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Design units to operate with HCFC-free refrigerants.

E. Test units by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 “Heating and Cooling Equipment” and bear the Listed Mark.

F. Rate the system components in accordance with AHRI Standard 210/240 “Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment”.

1.04 FLAMMABLE REFRIGERANTS

A. Equipment with refrigeration systems using Group A2L refrigerants shall meet all requirements of ASHRAE Std 15 and this section.

B. Listing and Installation Requirements:
1. Listed in accordance with UL 484 or UL 60335-2-40/CSA C22.2 No. 60335-2-40.
2. The nameplate shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing.
3. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.

C. Refrigeration systems shall have an integral refrigerant detection system that meets the following requirements as documented in ASHRAE Std 15:
1. Utilize a set point, nonadjustable in the field, to generate an output signal to initiate mitigation actions.
2. Field recalibration of refrigerant detection system shall not be permitted.
3. Be capable of detecting the presence of a specified refrigerant corresponding to the refrigerant designation of the refrigerant contained in the refrigeration system.
4. Have access for replacement of refrigerant detection system components.
5. Have self-diagnostics to determine operational status of the sensing element.
6. Energize air circulation fans of the equipment upon failure of a self-diagnostic check.
7. Generate an output signal in not more than 30 seconds when exposed to a refrigerant concentration of 25% LFL (+0%, -1%).

D. Manufacturer’s refrigeration mitigation action shall be completed in not more than 15 seconds after the initiation of the output signal of the equipment’s integral refrigerant detection system and shall be maintained for at least 5 minutes after the output signal has reset.

1.05 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
   1. Warranty Period, Compressors: Manufacturer’s standard, but not less than 5 years after date of Substantial Completion.

1.06 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Fan Belts: One set for each belt-drive fan.
   2. Gaskets: One set for each access door.
   3. One set of spare filters of each type required for each unit.
   4. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Carrier.

2.02 INDOOR UNITS

A. General: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.

B. Cabinet:
   1. Concealed: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Floor or Wall Mounted: Steel with baked enamel finish in color selected by Architect, easily removed and secured access doors with safety interlock switches.

C. Discharge Grille: Steel with surface mounted frame.

D. Insulation: Faced, glass-fiber duct liner.

E. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

F. Fan Motor:
   1. Comply with NEMA designation temperature rating, service factor, enclosure type, and efficiency requirements specified in Section "Common Motor Requirements for HVAC Equipment."

2. Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.

G. Air Filters: Washable type for wall-mount units, throwaway type for all other units, unless scheduled otherwise. Arrange for easy replacement. Refer to equipment schedules on the drawings for required thickness and MERV ratings.

H. Condensate Drain Pan: Slope in all directions to drain to drain connection that is sized to prevent overflow. Material options include:
1. Galvanized steel with top surface coating of asphaltic waterproof compound.
2. Stainless steel.
3. Polymer material.

I. Refrigerant Coil: Copper tube aluminum fin assembly, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

J. Controls:
1. Unit-mounted panel with contactors.
2. Control transformer with circuit breaker.
3. Solid-state temperature- and humidity-control modules.
4. Time-delay relay.

K. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
1. System selector switch (heat-off-cool) and fan control switch (auto-on).
2. Automatic switching from heating to cooling.
3. Preferential rate control to minimize overshoot and deviation from setpoint.
4. Battery replacement without program loss.

L. Where scheduled on the drawings, provide condensate lift pump with a built-in safety cutoff switch and integral check valve on discharge.

2.03 OUTDOOR UNITS

A. General: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

B. Compressor: Hermetic scroll-type with resilient suspension system, oil strainer, crankcase heater, start capacitor, time delay relay, contactor, and internal motor overload protection.

C. Air-Cooled Condenser:
1. General: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
2. Casing: Steel, baked enamel finish, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
3. Accessories:
   a. Liquid line filter drier.
   b. High pressure switch (manual reset).
   c. Low pressure switch (automatic reset).
   d. Service valve with gauge ports.
   e. Thermometer well in liquid line.
   f. Low-ambient kit where scheduled.

g. Compressor short-cycling controls.
h. Reversing valve for heat pump units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine area for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that flooring or ceiling system is ready to receive work and opening dimensions are as indicated on Shop Drawings.

C. Verify that power supply is available and of the correct characteristics.

3.02 COORDINATION

A. Coordinate layout and installation of units and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate installation of single rail equipment supports and roof penetrations with roof construction and actual equipment provided. Refer to “Hangers and Supports for HVAC Piping and Equipment” for equipment supports. Roof specialties are specified in Division 7 Sections. Concrete, reinforcement and formwork are specified in Division 3 Sections.

3.03 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Install unit level and plumb.

C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

D. Install roof-mounted, compressor-condenser components on roof equipment supports with vibration isolation. Anchor units to supports with removable, cadmium-plated fasteners.

E. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base or polyethylene mounting base with vibration isolators.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping and required valves and piping accessories. The following are specific connection requirements:
1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

D. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect ductwork to units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories." Provide transitions to exactly match unit duct connection size.

3.05 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust fan for required airflow in accordance with Section “Testing, Adjusting and Balancing.” Tighten belts as required for proper operation.

B. Adjust damper linkages for proper damper operation.

C. Set initial temperature and humidity set points.

D. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.06 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping, blocking, and bracing.
   2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects. Verify vibration isolation and flexible connections are installed correctly.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
   5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
   7. Comb coil fins for parallel orientation.
   8. Install new filters at completion of installation and prior to testing, adjusting, and balancing. Do not operate air handling unit without pre-filters installed.
   9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
   10. Disable automatic temperature control operators.

B. Start-Up Services: Start-up units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
   1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
      a. Replace fan and motor pulleys as required to achieve design conditions.

b. Measure and record motor electrical values for voltage and amperage.
c. Shut unit down and reconnect automatic temperature control operators.
d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.08 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 238126

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SECTION 238149
ROOFTOP HEAT PUMP UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Package rooftop heating and cooling heat pump units.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories.. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

C. Shop Drawings:
   1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.

D. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling heat pump 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.

E. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

F. Operation and Maintenance Data: Submit maintenance data and parts list for each heat pump unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Codes and Standards:

1. Test and rate rooftop heat pump units of 65,000 Btu/hr capacity or over in accordance with AHRI 340/360 “Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment”.
2. Test and rate rooftop heat pump units under 65,000 Btu/hr capacity in accordance with AHRI 210 “Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment” and provide Certified Rating Seal.
3. Test and rate sound performance of rooftop heat pump units in accordance with AHRI 270 “Sound Performance Rating of Outdoor Unitary Equipment”. Units shall bear Certified Rating Seal.
4. Comply with AHRI 1060 “Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment” for capacity ratings of air-to-air energy recovery equipment.
5. Construct refrigerating system of rooftop heat pump units in accordance with ASHRAE 15 “Safety Code for Mechanical Refrigeration”.
6. Equipment efficiencies for cooling and heating modes of rooftop heat pump units shall be equal to or greater than prescribed by ASHRAE 90.1 “Energy Standard For Buildings Except Low-Rise Residential Buildings”.
7. Rooftop heat pump units shall be listed by UL and have UL label as a unit.
8. Rooftop heat pump units shall be designed, manufactured, and tested in accordance with UL requirements. Comply with UL 1995 “Heating and Cooling Equipment”.

1.04 FLAMMABLE REFRIGERANTS

A. Equipment with refrigeration systems using Group A2L refrigerants shall meet all requirements of ASHRAE 15 and this section.

B. Listing and Installation Requirements:
1. Listed in accordance with UL 484 or UL 60335-2-40/CSA C22.2 No. 60335-2-40.
2. The nameplate shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing.
3. A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.

C. Refrigeration systems shall have an integral refrigerant detection system that meets the following requirements as documented in ASHRAE 15:
1. Utilize a set point, nonadjustable in the field, to generate an output signal to initiate mitigation actions.
2. Field recalibration of refrigerant detection system shall not be permitted.
3. Be capable of detecting the presence of a specified refrigerant corresponding to the refrigerant designation of the refrigerant contained in the refrigeration system.
4. Have access for replacement of refrigerant detection system components.
5. Have self-diagnostics to determine operational status of the sensing element.
6. Energize air circulation fans of the equipment upon failure of a self-diagnostic check.
7. Generate an output signal in not more than 30 seconds when exposed to a refrigerant concentration of 25% LFL (+0%, -1%).

D. Manufacturer’s refrigeration mitigation action shall be completed in not more than 15 seconds after the initiation of the output signal of the equipment’s integral refrigerant detection system and shall be maintained for at least 5 minutes after the output signal has reset.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept products, with factory-installed shipping skids and lifting lugs. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units. Inspect for damage.

B. Protect units from physical damage by storing off site or in locked, protected area until roof mounting curbs are in place, ready for immediate installation of units.

1.06 SPECIAL WARRANTY

A. Warranty on Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
   1. Warranty Period: 5 years from date of substantial completion.

1.07 SPARE PARTS

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling heat pump unit:
   1. One set of matched fan belts for each belt-driven fan.
   2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
   3. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS:

A. Greasemaster

B. Lennox Industries, Inc.

2.02 MANUFACTURED UNITS

A. General: Roof or slab mounted units, factory assembled, prewired and tested,

B. Description: Self-contained, packaged unit consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics shall be as scheduled on the Drawings.

C. Refrigerant: Provide rooftop units designed to operate with refrigerant as scheduled on the drawings.

2.03 FABRICATION

A. Cabinet: Provide manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs.
   1. Bottom Duct Connections: Provide steel or aluminum walking grate on structural supports where connections are located in sections accessible by personnel for maintenance.

B. Insulation: Minimum of 1" thick, 1.5 pound density thermal insulation.

C. Condensate Drain Pan: Provide galvanized or stainless steel condensate drain pan sloped to drain connection.

D. Filters Section: Provide filter housing of material matching the unit casing with gasketed filter media holding frames. Provide access panel large enough for filter replacement with continuous gasketing and positive locking devices.

E. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports and Section “Vibration Isolation for HVAC Piping and Equipment” for vibration isolated equipment support bases.

2.04 FANS

A. Supply Fans: Provide forward-curved or backward inclined, centrifugal fan wheel, V-belt drive with adjustable variable pitch motor pulley or direct drive, rubber isolated hinge mounted high efficiency motor and permanently lubricated motor bearings.

B. Condenser Fans: Provide propeller-type, direct-driven fans, resiliently mounted with fan guard with permanently lubricated bearings.

2.05 MOTORS:

A. Motors: Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.

2.06 AIR FILTRATION

A. Final Filters Section: Provide 2" thick fiberglass throwaway pleated filters in filter rack, with maximum face velocity of 400 fpm and minimum MERV rating per ASHRAE 52.2 of MERV 13.

2.07 ELECTRIC HEAT SECTIONS:

A. Provide manufacturer's standard construction electric heat coils, factory-wired for single point wiring connection, complete with control circuit transformer and fuse, airflow proving device, over-current and over-heat protection devices.

B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.08 EVAPORATOR COIL

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant.

C. Provide interlaced coils in multiple stage units to ensure full coverage over coil face.

D. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of refrigerant.

E. Provide corrosion protective coating where scheduled.

F. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.

2.09 HOT GAS REHEAT COIL:

Provide hot gas reheat coil with staged or modulating control for reheat during dehumidification operation. Size hot gas reheat coil capacity to maintain space temperature when unit is operating in the dehumidification mode with no load in the space. Refer to control drawings.

2.10 COMPRESSORS:

A. Provide serviceable, semi-hermetic, or hermetic compressors with integral vibration isolators, and crankcase heaters which de-energize during compressor operation. Units shall also have:
1. Cylinder unloaders for capacity control, with minimum steps as scheduled.

B. Provide reversing valve, suction line accumulator, flow control check valve, and solid state defrost control utilizing thermistors.

C. Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors; and fan-cycling control for low ambient control to 25 deg F (2 deg C).

2.11 CONDENSER COIL

A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.

B. Provide corrosion protective coating where scheduled.

C. Provide refrigerant pressure switches to cycle condenser fans.

2.12 MIXED AIR CASING

A. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section “Instrumentation and Control Devices for HVAC.”

B. Outdoor Air Damper:
1. Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
2. Refer to schedules and control diagrams on the drawings for quantity, capacity and control method of the outdoor air dampers of each unit.

C. Economizer Control:
1. Provide economizer system complete with return and outside air dampers, outside air filter, fully modulating electric control system with dry bulb or enthalpy control as noted on the drawings, and adjustable mixed-air thermostat.
2. System shall have 100 percent outside air capability.
3. Provide automatic changeover through adjustable control device.

D. Relief Damper: Provide a relief damper with control type as scheduled on the drawings.

2.13 OPERATING CONTROLS:

A. Provide solid-state control board and components that contain at a minimum the following features in addition to control features specified in the contract documents:
1. Indoor fan on/off delay.
2. Default control to ensure proper operation after power interruption.
3. Service relay output.
4. Unit diagnostics and diagnostic code storage.
5. Field-adjustable control parameters.
6. Fan-proving switch to lock out unit if fan fails.

B. DDC Interface: Install stand-alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 section "Direct Digital Control for HVAC”.

C. Thermostat: Programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:
1. Touch sensitive keyboard.
2. Automatic switching.
3. Degree F readout.
4. LED indicators.
5. Hour/day programming.
6. Manual override capability.
7. Time and operational mode readout.
8. Status indicator.
9. Battery backup.
10. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

2.14 SAFETY CONTROLS:

A. Provide the following:
1. Low pressure cutout, manual reset;
2. High pressure cutout, manual reset;
3. Compressor motor overload protection, manual reset;
4. Anti-recycling timing device;
5. Adjustable low-ambient lockout;
6. Oil pressure switch.

2.15 ELECTRICAL

A. Provide a 125 VAC, 20 amp duplex convenience receptacle mounted to unit ready for field wiring through the curb with a cover UL listed for wet and damp locations when in use.

B. Unit power connection shall be either through unit cabinet or within roof curb perimeter.

C. Rooftop heat pump units shall be designed to meet the minimum short-circuit withstand rating specified on the drawings.

2.16 ACCESSORIES:

A. Units shall include the following accessories where scheduled or shown on the drawings:
1. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.
2. Low ambient control head pressure control, designed to operate at temperatures down to 25 deg F, where indicated on schedule.
3. Provide guards to protect the condenser coil from hail or other damage.
4. Provide birdscreens on outside air inlets to units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions under which rooftop units are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. For roof installed units, verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

D. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF ROOFTOP HEATING AND COOLING HEAT PUMP UNITS

A. General: Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Secure roof-mounted units to roof equipment supports and grade-mounted units to curbs or base. Refer to the drawings for the type of support required for each rooftop unit.
   1. Refer to Section “Hangers and Supports for HVAC Piping and Equipment” for standard roof curbs.
   2. Refer to Section “Vibration Isolation For HVAC” for vibration isolation curbs.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
   1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

D. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.

E. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

F. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust fan for required airflow in accordance with Section “Testing, Adjusting and Balancing for HVAC.” Tighten belts as required for proper operation.

B. Adjust damper linkages for proper damper operation.

C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping, blocking, and bracing.
   2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.

5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters. Do not operate air handling unit without pre-filters installed.
9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
10. Disable automatic temperature control operators.

B. Start-Up Services: Provide the services of a factory-authorized service representative to start-up rooftop heat pump units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
    a. Replace fan and motor pulleys as required to achieve design conditions.
    b. Measure and record motor electrical values for voltage and amperage.
    c. Shut unit down and reconnect automatic temperature control operators.
    d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.05 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 238149

SECTION 238500
ELECTRIC HEATING UNITS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES:

A. Commercial Electric Wall Heaters

B. Electric Duct Heaters

1.02 SUBMITTALS

A. Submit Shop Drawings as required by Division 1.

B. Submit product data for each type and size of electric heater.

C. Shop Drawings indicating volts, phase, watts and all options that will be provided.

D. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

E. Shop Drawings showing fabrication and installation of electric resistance heating units including plans, elevations, sections, details of components, and attachments to other units of Work.

F. Color Samples: Submit color samples for each type of cabinet finish furnished for Architect selection.

G. Maintenance data for electric resistance heaters to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions for cleaning.

1.03 REGULATORY REQUIREMENTS

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing radiant heating panels similar to those indicated for this Project and that have a record of successful in-service performance.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in NFPA 70 “National Electrical Code”, Article 100.
      a. Comply with NFPA 70 for components and installation.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
   3. Fire-resistance-rated, gypsum board assemblies are identical to design designations in listing and labeling agency's product directory.

C. Provide products listed and classified by Underwriter’s Laboratories, Inc. as suitable for purpose intended. Comply with UL 1995 “Heating and Cooling Equipment”.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Provide electric heaters of voltage, size and capacity as indicated on the Drawings.

B. Electric heaters shall be designed for a single circuit supply and provided with a single integral, factory-mounted power disconnect switch. Heating elements, motor and control circuits shall be subdivided and fused.

C. Elements shall consist of helically coiled nickel chromium alloy resistance wire embedded and completely surrounded in magnesium oxide, enclosed in corrosion resistant sheaths and permanently attached to corrosion resistant steel fins.

D. Motors shall be totally enclosed industrial type, permanently lubricated and equipped with thermal overload protection with automatic reset. Motors shall be mounted on a heavy gauge formed metal bracket. After the thermostat has been satisfied, the fan shall continue to run until residual heat has been dissipated.

E. Electric heaters shall be equipped with an automatic reset thermal cutout which disconnects elements and motors in the event normal operating temperatures are exceeded.

F. Contactors, relays and control transformers shall be factory assembled and wired.

G. Provide 24 volt factory wired thermostat.

2.02 COMMERCIAL ELECTRIC WALL HEATERS

A. Manufacturers:
1. Berko
2. Brasch
3. Erincraft
4. King Electric
5. Markel
6. Q Mark
7. Raywall
8. Redd-i Products
9. Sentinel

B. Provide 20 gauge galvanized steel back boxes for wall heaters.. Paint enclosures for surface mounted wall heaters with a dark brown enamel finish. Mount recessed heaters 6” above the finished floor.

C. Provide grilles with dark brown baked enamel finish. Trim grilles with an extruded aluminum frame.

D. Provide factory mounted controls.
1. Conceal controls behind a removable cover.

2.03 ELECTRIC DUCT HEATERS

A. Manufacturers:
1. Berko.
2. Brasch.
3. Chromalox.
4. Indeeco.
5. Markel.
6. Neptronic.
7. Raywall.
8. Thermolec.
9. Tutco.

B. Heaters shall be UL or ETL approved and have a U.L. or ETL label affixed to the terminal box for zero clearance of the heaters and their installation shall meet applicable requirements of the latest edition of the National Electric Code.

C. Heating Elements:
1. Open Coil Type: Provide open coil type, 80% nickel, 20% chromium, Grade A supported with adequate ceramic bushings and supporting brackets. Machine crimp coils into stainless steel terminals.

D. House heating elements in a galvanized steel frame of roll-formed construction with multiple brakes and ribs for stiffness and rigidity. Furnish heaters rated over 150 KW with heavy duty coils, derated to 35 watts per square inch of wire surface. Balance the load of three phase coils equally between phases for steps of control.
1. Provide insulated terminal box to minimize condensation where heater is installed in a duct that will have cold air during cooling mode.

E. House terminals, temperature control devices, safeties, etc in a galvanized steel box of NEMA 1 construction with a hinged, latching cover and multiple concentric knockouts for field wiring. Where coils are mounted side by side, locate terminal boxes on the bottom of the coil.

F. Duct Heater Controls:
1. Include a factory wired non-fused disconnect switch and internal branch circuit fuse protection as required by UL and the NEC whenever the total heater draw is 48 amps or greater (48 amps per step maximum). On heaters less than 48 amps, provide a factory wired fused disconnect switch.
2. Include manual and automatic overheat protection, pressure type airflow switches and safety contactors.
3. Provide magnetic type operating contactors, where required for on/off or step control operation.
4. Provide step controllers, silicone-controlled rectifiers (SCR), or combination of silicone-controlled rectifiers (SCR) and step controllers as scheduled on the drawings, designed to control the heater output from 0 to 100 percent of heater capacity.
5. Automatic reset overheat protection cutouts shall utilize linear sensing elements for coils over 72 inches wide.
6. Operating controls and circuits shall be compatible with the type of temperature controls specified.

G. Where heaters are installed in ductwork having internal insulation (lining), reduce the coil open face area in height and width to match the duct free area.
   1. Provide insulated control panels where heaters are installed in ductwork that could have condensation due to cold air flowing through the heater.

H. Field install baffle plate, air straighteners or vanes at duct heaters, if required to ensure even airflow across the coil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions are acceptable prior to beginning installation.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Locate each unit in the position indicated.

C. Install units with sufficient clearance from adjacent construction, piping, ductwork and other obstructions to allow access for service and maintenance.

D. Support unit heaters from structure.

E. Install flush-mounted units tight to the wall or ceiling. The unit trim shall cover the opening.

3.03 FIELD QUALITY CONTROL

A. Verify operation of each electric heating unit by measuring input voltage and current simultaneously for period of ten minutes of continuous operation.

3.04 DEMONSTRATION

A. Demonstrate location and setting procedures for thermostats and other heating controls.

END OF SECTION 238500

SECTION 260000
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DIVISION 26 - ELECTRICAL SPECIFICATION

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SECTION 260010
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and to all following sections within Division 26.

1.02 SECTION INCLUDES

A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.

B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. Drawings are graphic representations of the Work upon which the Contract is based. The Contractor will show the materials and their relationship to one another, including sizes, shapes, locations, and connections. The Contractor also conveys the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.03 DEFINITIONS

A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:
   1. Furnish: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
   2. Install: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."

3. Provide: “To furnish and install complete, and ready for the intended use.”
4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: “An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division.
    a. A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. Contract Administrator: Where referenced in this Division, “Contract Administrator” is the primary liaison between the Owner and the Contractor. Specifically, for this project this is the “Architect”.
7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
8. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
9. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
    a. 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.
    b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
10. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
11. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified

B. When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

C. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

D. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   3. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference, unless otherwise noted.

1.04 REFERENCE STANDARDS

A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Engineer's attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.

B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.

C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.

D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

IBC	International Building Code
FBC	Florida Building Code
SBC	Standard Southern Building Code
ADA	Americans with Disabilities Act
AEIC	Association of Edison Illuminating Companies
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
ICEA	Insulated Conductors Engineers Association
IEEE	Institute of Electrical and Electronics Engineers

IES	Illuminating Engineering Society
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code, NFPA 70
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufactures' Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
UL	Underwriter's Laboratories

E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.

G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.

B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.

C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.

D. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

E. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes installed.

F. Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

G. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a

manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.

H. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

1.06 MEASUREMENTS AND LAYOUTS:

A. The Drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.07 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
   1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
   2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
   3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
   4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
   6. Indicate required installation sequence to minimize conflicts between entities.
   7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.

B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.

1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
4. Include work provided by others routed through the equipment rooms.

1.08 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.

C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.

E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

I. Refer to individual Sections for additional submittal requirements.

J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Submittals shall contain the following information:
1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

1.09 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:
1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, Construction Manager, and Owner the following:
    a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
    d. Same warranty will be furnished for proposed substitution as for specified Work.

e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.

f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. Prior to receipt of Bids: No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
   a. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
3. After receipt of Bids: No substitutions will be considered after receipt of Bids and before award of the Contract.
4. After award of Contract: No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet.

B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.

C. The following must be received before electronic drawing files will be sent:

1. Engineer’s release agreement form
2. Payment

1.11 QUALITY ASSURANCE

A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.

B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.

C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.12 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish the Operation and Maintenance Manuals to the Contract Administrator, for Engineer’s review, and for the Owner’s use.
   1. Refer to Division 01 for acceptance of electronic manuals for this project. If not specified in Division 1, provide manuals in the form of a multiple file composite electronic PDF file for each manual type required. Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size. 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.
      a. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator’s and Engineer’s designated representatives.
   2. If Division 01 requires paper manuals, provide four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings.

E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

1.13 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections of this Division

1.14 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.

D. Be responsible for the safe storage of tools, material and equipment.

1.16 WARRANTIES

A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer’s standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.

D. Also warrant the following additional items:
   1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
   2. All raceway seals are effective.
   3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.

E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.

G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one-year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.17 TEMPORARY FACILITIES

A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
   1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
   2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees F. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.
      a. Vent and exhaust fuel-burning heaters per SMACNA Guidelines for Source Control and equip units with individual-space thermostatic controls.
      b. If permanent HVAC systems are used during construction, provide HVAC Protection and replace all filtration prior to occupancy in accordance with SMACNA Guidelines.

1.18 FIELD CONDITIONS

A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:

1. The Drawings describe the general nature of remodeling to the existing building; however, visit the site prior to submitting bid to determine the nature and extent of work involved.
2. Schedule work in the existing building with the Owner.
3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves electrical systems, Light fixtures, equipment, raceways, equipment supports or foundations and materials.
4. Remove articles that are not required for the new work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state and local regulations.
5. Relocate and reconnect electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.
6. Finish material will be installed under other divisions.
7. Obtain permission from the Contract Administrator for roof penetrations and channeling of floors or walls not specifically noted on the Drawings.
8. Protect adjacent materials indicated to remain. For work specific to this Division, install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
9. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, provide temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services that transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

D. Use of explosives is not permitted, unless otherwise specified or allowed for powder-actuated tools.

E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 PRODUCTS AND MATERIALS

2.01 SOIL MATERIALS

A. Sub base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than two inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.02 EXISTING CONDITIONS

A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.

B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.

C. Notify Contract Administrator immediately of any dangerous conditions that exist on the job site, as they are discovered, before demolition, during selective demolition or before remodel work begins.

3.03 EXISTING UTILITIES

A. Prepare and submit a schedule of anticipated utility outages indicating dates and duration. Schedule

B. Schedule and coordinate with the utility companies, Owner and with the Contract Administrator all connections to, relocation of, or discontinuation of normal utility services from any existing utility line. Include all premium time required for all such work in the bid.

C. Repair all existing utilities damaged due to construction operations to the satisfaction of the Owner or utility companies without additional cost.

D. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.

E. Make repairs and restoration of utilities before workers leave the project at the end of the workday in which the interruption takes place.

F. Include in bid the cost of furnishing temporary facilities to provide all services during interruption of normal utility service.

3.04 WORK IN EXISTING FACILITIES

A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the site prior to submitting a bid, to determine the nature and extent of work involved.

B. Schedule work in the existing facility with the Owner.

C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves electrical systems, fixtures, conduit, wiring, equipment, equipment supports or foundations and materials.

D. Remove all of these articles that are not required for the new work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.

E. 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 Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
   3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.
   4. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.

F. Relocate and reconnect all electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical fixtures or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.

G. Finish materials are specified in other divisions.

H. Where removal of existing wiring interrupts electrical continuity of circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued electrical continuity.

I. Penetrate roofs, channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all penetrations and channeling not specifically noted on the Drawings.

J. Provide new, typewritten card directory for distribution equipment (including but not limited to load centers, panelboards, switchboards and switchgear) where changes occur under this scope of work. Indicate exact loads served by each existing circuit breaker or switch. Where circuit designations are not specifically indicated on the Drawings, provide a unique identifier for each updated circuit within the directory.

K. Coordinate work with Architectural phasing drawings to properly stage transitions of work to provide power to existing, new and temporary loads. Monitor loads on distribution system to ensure shifting of loads does not overload electrical equipment.

L. Work in common areas, shafts or other Owner owned and/or operated spaces must be reviewed and approved by the Contract Administrator, Landlord and Owner prior to commencement of the work.
   1. Contractor shall minimize any disruption and disturbances to other tenants. All work within other tenant spaces must be coordinated with and approved by the Landlord and Owner.

3.05 PERMITS

A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.06 TEMPORARY ELECTRICAL SERVICE AND WIRING

A. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.

B. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.

C. Pay all charges made by the Electric Utility, with respect to installation and energy charges for temporary services.

D. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.

E. Install all temporary wiring in accordance with applicable codes and maintain in an OSHA-approved manner.

F. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.

G. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).

H. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.

I. If additional service is required for cranes, electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.

J. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.

K. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

3.07 SELECTIVE DEMOLITION

A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.

B. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

C. Materials and Equipment To Be Salvaged: remove, demount, disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

E. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:
      a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
      b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 26.

3.08 ACCESS TO EQUIPMENT

A. Locate all pull boxes, junction boxes and controls to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section “Common Work Results for Electrical”.

B. Maintain all code required clearances and clearances required by manufacturers.

3.09 PENETRATIONS

A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 26 Section “Common Work Results for Electrical”.

B. Provide sleeves, box frames, or both, for all conduit, cable, and busways that pass through masonry, concrete or block walls.

C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

3.10 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.

C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.

D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.

E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.

F. Slope sides of excavations to comply with local, state, and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state, and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks and Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots

with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.

2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for electrical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.
2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For raceway and cables less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of raceway and cables, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas use excavated or borrowed materials.

O. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less that 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.

Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

T. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.11 CUTTING AND PATCHING

A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.

B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.

D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.

E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.12 PAINTING

A. Refer to Division 09 Section “Painting” for painting requirements.

B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.

C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer’s instructions for pre-cleaning surfaces and application.

D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.

E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.13 CLEANING

A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Electrical Contractor shall clean material and equipment installed under the Electrical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment.

C. Damaged finishes shall be touched-up and restored to their original condition

3.14 ADJUSTING, ALIGNING AND TESTING

A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.

B. Check motors for alignment with drive and proper rotation and adjust as required.

C. Check and test protective devices for specified and required application and adjust as required.

D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.

E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.

F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.

G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.

H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.

I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.

J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.

K. Refer to individual sections for additional and specific requirements.

3.15 START-UP OF SYSTEMS

A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.

B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.

C. Adjust taps on each transformer for rated secondary voltages.

D. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.

E. Replace all burned-out lamps. Replace the lamps of all light fixtures that use incandescent, halogen or quartz lamp sources that are installed as part of the finished building, but are used by the Contractor during construction, with new lamps of appropriate type and wattage prior to turning the facility over to the Owner.

F. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.

G. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.

H. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

3.16 TEST REPORTS

A. Perform tests as required by these Specifications and submit the results to the Contract Administrator, for Engineer's review. Record the results, date and time of each test and the

conditions under which the test was conducted. Include a copy of the finalized test results, with corrections made, in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.

B. For specific testing requirements of special systems, refer to the Specification section that describes that system. The Contractor shall provide the following to facilitate the testing of the electrical systems:
   1. Perform tests as described in the individual sections.

C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:
   1. Building service entrance voltage and amperes at each phase.
   2. Electrical service grounding conditions and grounding resistance.
   3. Proper phasing throughout the entire system.
   4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
   5. Phase voltages and amperes at each three-phase motor.
   6. Test all wiring devices for electrical continuity and proper polarity of connections.

D. Promptly correct all failures or deficiencies revealed by these tests in accordance with the manufacturer's recommendations and as determined by the Engineer.

3.17 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:
   1. Submit complete Operation and Maintenance Data.
   2. Submit complete Record Drawings.
   3. Perform all required training of Owner's personnel.
   4. Turn over video recordings of training sessions to the Owner.
   5. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
   6. Perform start-up tests of all systems.
   7. Remove all temporary facilities from the site.
   8. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.

B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days' notice prior to the review.

C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, the Contractor shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Contract Administrator will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 260010

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

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SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:
   1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
   2. Sleeves and seals for electrical penetrations.
   3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
   4. Sealing penetrations through noise critical spaces.

1.02 DEFINITIONS

A. The following abbreviations apply to this and other Sections of these Specifications:
   1. AHJ: Authority(ies) having Jurisdiction
   2. ATS: Acceptance Testing Specifications
   3. EPDM: Ethylene-propylene-diene monomer rubber
   4. MC: Metal Clad
   5. NBR: Acrylonitrile-butadiene rubber
   6. NRTL: Nationally Recognized Testing Laboratory
   7. PCF: Pounds per Cubic Foot

B. The following definitions apply to this and other Sections of these Specifications:
   1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
   4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS AND MATERIALS

2.01 ACCESS TO EQUIPMENT

A. Available Manufacturers:
1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:
1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Electrical Systems” for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
    a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
8. Locking Devices: Flush, screwdriver-operated cam locks.

2.02 SLEEVES

A. Steel sleeves for raceways and cables:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends and drip rings.

B. Cast iron wall pipe sleeves for raceways and cables:
   1. Manufacturers
      a. Josam Mfg. Co.
      b. Smith (Jay R) Mfg. Co.
      c. Tyler Pipe/Wade Div.; Subs of Tyler Corp.
      d. Watts Industries, Inc.
      e. Zurn Industries, Inc.; Hydromechanics Div.
   2. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with setscrews.
   3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
   4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

2.03 SEALANTS

A. JOINT SEALERS
   1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
   2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.
   3. Elastomeric Joint Sealers: Provide the following types:
      a. Silicone Joint Sealants, One-part nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
         1) Dow Corning, Dowsil 790
         2) Dow Corning, Dowsil 795
         3) GE, Silglaze II SCS 2350
         4) GE, Silpruf SCS 2000
         5) Owens Corning, Energy Complete
         6) Pecora, 864 NST
         7) Tremco, Spectrem 1
         8) Tremco, Spectrem 2
      b. Mildew Resistant Sealants, one-part mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
         1) Dow Corning, Dowsil 786
         2) GE, Momentum SCS 1700
         3) Pecora, 898 Silicone NST
      c. Hybrid Joint Sealants: One-part, nonsag, paintable complying with ASTM C 920, Type S, Grade NS, Class 50 recommended for exposed applications on interior and

exterior locations involving joint movement of not more than plus or minus 50 percent. Subject to compliance with requirements, provide one of the following:

1) BASF, MasterSeal NP 100
2) Pecora, DyanTrol I-XL
3) Tremco, Dymonic FC

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)

C. Comply with NECA 1.

D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.

E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

G. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.02 ACCESS DOORS

A. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

C. Label all access doors with a nameplate as described in Division 26 Section "Identification for Electrical Systems".

3.03 SLEEVES AND SLEEVE SEALS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.

C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.

D. Construction in Existing Facilities:
   1. Saw cut or core drill existing walls, roofs and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls, roofs or slabs without first coordinating with, and receiving approval from, the Contract Administrator, Owner, or both. Seal sleeves into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Contract Administrator. Provide roofing penetration seals and covers to match existing roofing materials. Coordinate roofing repair of adjacent roofing material with Owner's roofing contractor to provide a waterproof installation.

E. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.

F. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

G. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

H. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

I. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.

J. Sleeve Length:
   1. Sleeves through walls: Cut sleeves to length for mounting flush with both surfaces of walls.
   2. Sleeves through floors: Extend sleeves 2 inches above finished floor level.

K. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed; in which case, size sleeves as recommended by the seal manufacturer.

L. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

M. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint

N. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

O. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

P. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

Q. Above Grade Concrete or Masonry Penetrations
   1. Provide sleeves for cables or raceways passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
      a. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
      b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.
      c. Install galvanized sheet metal for rectangular sleeves
      d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
   2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

R. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. Provide mechanical sleeve seal.
   1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
   2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

S. Concrete Slab on Grade Penetrations:
   1. Provide ½" thick cellular foam insulation around perimeter of raceway passing through concrete foundation. Installation shall extend to 2" above and below the concrete slab.

T. Elevated Floor Penetrations of waterproof membrane:
   1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum ½" annular space between wall pipe and cable or raceway.
   2. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.
   3. Secure waterproof membrane flashing between clamping flange and clamping ring.
   4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

U. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.

V. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

W. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.

X. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

Y. Sleeve-Seal Installation
1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Z. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.

AA. Sleeves shall be protected throughout the course of construction, and when damaged shall be replace and/or repaired to a satisfactory condition.

3.04 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.05 JOINT SEALERS

A. Preparation for Joint Sealers
1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.
2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

B. Application of Joint Sealers
1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical raceways penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.06 ACOUSTICAL PENETRATIONS

A. Do not allow direct contact of raceways with shaft walls, floor slabs and/or partitions. Sleeve, pack and seal airtight with foam rod, non-hardening sealant and/or packing material, as described herein, for all penetrations by raceway, through surfaces that encompass or are between noise critical spaces. Seal and pack with caulking for the full depth of the penetration all openings around raceways in the structure surrounding the electrical equipment and surrounding noise-critical spaces. This includes all slab penetrations and penetrations of noise critical walls.

B. Where a raceway passes through a wall, ceiling or floor slab of a noise critical space, cast or grout a metal sleeve into the structure. The internal diameter or dimensions of the sleeve shall be 2 inches larger than the external diameter or dimensions of the raceway passing through it. After all of the raceways are installed in that area, check the clearances and correct, if necessary, to within 1/2-inch. Pack the voids full depth with packing material sealed at both ends, 1-inch deep, with non-hardening sealant backed by foam rod.

END OF SECTION 260500

SECTION 260502
EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.

B. Coordinate with work described in Division 23 Section “Common Work Results for HVAC”.

C. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

D. Determine connection locations and rough-in requirements based on shop drawings.

E. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

F. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.
   2. Marked for intended use.

B. Comply with NFPA 70.

PART 2 PRODUCTS AND MATERIALS

2.01 CORDS AND CAPS

A. Attachment Plugs: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.

C. Cord: See Paragraph “Flexible Cords” in Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.02 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

B. Provide fire-resistive protective assembly or an electrical circuit protective system for feeders and control circuit conductors and cables having a fire-resistance rating of not less than 2 hours where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
1. Feeders for Emergency Power systems
2. Smokeproof Enclosure Pressurization systems
3. Smoke Removal systems
4. Fire service and Occupant Evacuation Elevator systems

3.03 ELECTRICAL DEVICES

A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) as indicated, specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.04 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturers' instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated on the Drawings.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.05 EQUIPMENT

A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.

B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.

C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.

D. Motorized Damper: Provide lockable toggle, pilot lighted disconnect switch in an accessible location at each motor actuator, or group of motor actuators.

3.06 FOOD SERVICE (SERVERY) EQUIPMENT

A. Provide power connection to all equipment as indicated or as otherwise required to accommodate the equipment indicated in the food service equipment drawings and specifications.

B. Coordinate and provide the appropriate receptacle for equipment being installed as required for proper operation. Coordinate the required quantity of conductors prior to pulling wire to outlet box.

C. Provide a local recessed non-fused equipment disconnect for kitchen equipment as required by the applicable codes and jurisdictions. Coordinate exact location prior to rough-in and maintain all code required clearances.

D. Provide control wiring and conduit for all equipment that is not indicated as being within the responsibility of the equipment manufacturer or installer.

E. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, shall be provided by the equipment installer, unless otherwise noted.

F. Coolers and Freezers: Cut conduit openings in freezer and cooler walls, floor, and ceilings, in accordance with manufacturers' instructions, when openings are not provided by the manufacturers. Seal around conduit penetrations air tight with an approved pliable material suitable for low temperatures. Effectively seal interiors of conduits, by installing a conduit fitting at the boundary of the two spaces, and filling it with an approved pliable material, after conductors or cables have been installed and tested.

G. Provide all grounding systems as required by the equipment supplier.

3.07 DOOR OPERATORS AND HARDWARE

A. Provide electrical connections to automatic entry doors, automatic corridor doors, electrically held door latches, remote release doors, and all other required electrical connections for door systems included in other sections of these specifications.

B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.

C. Provide all control wiring and conduit for all equipment that is not included within the responsibility of the door hardware installer. Provide connection from junction boxes to the door operators or hardware and from door operators to actuation devices as required. Install key operated switches, push pad switches, and other electrically controlled door operation devices furnished by other divisions within this contract.

D. Provide fire alarm devices and wiring as required for proper operation of door systems in accordance with the NFPA codes.

END OF SECTION 260502

SECTION 260504
PROVISIONS FOR ELECTRIC UTILITY SERVICE

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Provisions for Underground Secondary Electrical Service.

1.02 GENERAL REQUIREMENTS

A. Utility service voltage:As indicated on the Drawings.

B. Utility service ampacity: As indicated on the Drawings.

C. The extent of Work for the secondary electrical service includes providing the following:
   1. Raceways
   2. Provisions for Metering
   3. Grounding and Bonding
   4. Service lateral
   5. Utility coordination

1.03 QUALITY ASSURANCE

A. Perform all work in accordance with Utility Company installation drawings and service standards.

B. Maintain one copy of Utility Company installation drawings and service standards at the site.

C. Prior to commencing work in this Section, meet with the Utility Company representative to review service entrance requirements and details.

D. Verify that field measurements are as indicated on Utility Company drawings.

E. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
   2. Marked for intended use.

F. Comply with NFPA 70.

PART 2 PRODUCTS AND MATERIALS
(Not Used)

PART 3 EXECUTION

3.01 SECONDARY SERVICE ENTRANCE UNDERGROUND

A. Provide an underground secondary service lateral from the pad mounted transformer in accordance with NFPA 70 Article 230 and the Utility Company standards. Reference the Drawings for service lateral conductor and raceway quantities, sizes, and types.

B. The Utility Company will provide the service transformer.

C. Make connections to the secondary terminals of the transformer as required and in conformance with Utility Company requirements. Utility Company will provide primary conductors and terminal connections unless otherwise directed by the Utility Company.

D. Provide underground raceways for primary cables from the transformer pad to the property line, and provide pull cord, per Utility Company standards, for the Utility Company's use in pulling primary conductors. Install raceways a minimum of 24 inches below finished grade line unless otherwise indicated on the Drawings or directed by the Utility Company. Provide excavation and backfill as required to accomplish the installation.

3.02 METERING

A. Provide a meter base complying with the Utility Company standards.

B. The Utility Company will provide the meter and meter wiring.

3.03 UTILITY SERVICE CHARGES

A. It shall be the responsibility of the Division 26 contractor to apply for the electrical service, including the preparation and completion of all forms. Submit the completed application along with all other required documentation for the new or modified service.

B. Pay all Utility Company charges for providing electric service, including all charges for bringing primary service conductors to the site.

3.04 FIELD QUALITY CONTROL

A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:
   1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each secondary unit substation. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
   2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:
      a. Rebalance loads.
      b. Prepare written request for voltage adjustment by electric utility.

END OF SECTION 260504

SECTION 260510
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes general construction materials and methods, communications equipment coordination, and common communications installation requirements as follows:
   1. Pathways for Communications Systems
      a. Conduits and Backboxes
      b. Floor Boxes and Poke Throughs
      c. Access doors
      d. Fire Stop System Assemblies for Communications Systems
   2. Telecommunications Backboards
   3. Grounding and Bonding for Communications Systems

1.02 DEFINITIONS

A. Backbone Bonding Conductor (BBC) – The conductor that interconnects elements of the telecommunications grounding infrastructure.

B. Communications Room - means the location of a floor-serving facility for housing telecommunication equipment, and potentially other low-voltage systems such as audio-visual, security and fire alarm (electronic safety and security) equipment. Also known as Telecommunications Room, Telecom Room, IT Room, MDF, or IDF.

C. Ground or Grounding – A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

D. IDF – Intermediate Distribution Frame, secondary Communications Room(s) for a building

E. IMC – Intermediate Metal Conduit

F. MDF – Main Distribution Frame, the Main Communications Room for a building

G. Point of Entrance (Building Entrance) – The point within a building where the Outside Plant (OSP) communications cabling emerges from an external wall, a concrete floor slab, or IMC/RMC. If Communications Point of Entrance isn't identified on the drawings, assume the Main Communications Room (MDF) also acts as the Point of Entrance.

H. Primary Bonding Busbar (PBB) – A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

I. RCDD – Registered Communications Distribution Designer as certified by BICSI

J. RMC – Rigid Metal Conduit

K. Secondary Bonding Busbar (SBB) – A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

L. STC – Sound Transmission Class, a single number decibel rating of the transmission loss properties of an assembly. Measured transmission loss data is plotted versus frequency and compared with standard contours according to rules outlined in ASTM E 90 and ASTM E 413.

M. Telecommunications Bonding Backbone (TBB) – A conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).

N. Telecommunications Bonding Conductor (TBC) – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground.

1.03 REFERENCE STANDARDS

A. The references to the following standards and guidelines represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the correct revision or printing (UON).
   1. TIA-569 – "Telecommunications Pathways and Spaces"
   2. TIA-607 – "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
   3. ANSI/NECA/BICSI 607-2011 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
   4. BICSI Telecommunications Distribution Methods Manual (TDMM)
   5. Telecommunications Service Provider Pathway Requirements

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate arrangement, mounting, and support of communications equipment with Telecommunications equipment furnished by Owner and Telecommunications service providers.

B. Coordinate arrangement, mounting, and support of communications equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
   3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

E. Coordinate testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.05 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
   1. Product data for the following products:
      a. Floor Boxes and Poke Throughs
      b. Cable Trays
      c. Telecommunications ground bars and connectors

   Record Documents:
      d. Resubmittal of approved product submittals, with installation and O&M manuals.
      e. Floor plans shall show the routing of all pathways and firestop locations (with quantity and NRTL system number identified) as actually installed. Each pathway shall be identified by type and size on the drawings.
      f. Letter stating that the Telecommunications Grounding and Bonding System has been installed in accordance with the referenced standards and contract documents, including testing requirements.

1.06 QUALITY ASSURANCE

A. All cable supports shall be manufactured by a company which produces cable supports. No field made apparatus will be accepted without prior written approval.

PART 2 PRODUCTS AND MATERIALS

2.01 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. Raceways and Boxes for Communications Systems
   1. General Requirements
      a. Refer to Division 26, "Raceways and Boxes for Electrical Systems" for Available Manufacturers and other specific product, material and installation requirements.
      b. Outlet boxes located in plenum accessible ceiling space shall be listed for installation in a plenum.
      c. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers models that meet the specified criteria.
   2. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in stud walls:
      a. Requirements:
         1) Minimum size of 4-11/16 inches (119.1 mm) width by 4-11/16 inches (119.1 mm) height by 2-1/8 inches (54 mm) depth
         2) with a single-gang raised cover/extension ring a minimum of 3/8" deep. Depth shall match that of wall gypsum board(s)
      b. Manufacturers:
         1) Emerson/Appleton
         2) Hubbell RACO
         3) Randl

4) ABB/Thomas & Betts/Steel City

3. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in masonry construction:
   a. Requirements:
      1) Minimum size shall be single gang, a minimum of 3-1/2 inches deep.
   b. Manufacturers:
      1) Emerson/Appleton
      2) Hubbell RACO
      3) Randl
      4) ABB/Thomas & Betts/Steel City

B. Floor Boxes
   1. General:
      a. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the tables below. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Manufacturers listed above and models that meet the specified criteria.
      b. UL514A listed for scrub water exclusion for all floor types.
      c. Provide a complete Floor Box Assembly.
      d. Floor boxes used for power: Electrical receptacle(s) shall be provided per Division 26 Section "Wiring Devices" or as indicated on the Drawings. Refer to Electrical Drawings and Division 26 Specifications for receptacle types, quantities and colors. Unless otherwise noted, all floor boxes shall contain electrical power receptacles. If no requirements are listed elsewhere, provide a minimum of one normal 20A, 125V NEMA 5-20R duplex receptacle.
      e. Floor boxes utilized for communications: Include provisions for mounting communications faceplate and connectors in accordance with the requirements of the communications systems provider.
   2. **Floor-mounted Telecommunications Outlet (Telephone and/or Data connections only):** For slab on grade: watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Contract Administrator. Shallow slab-on-grade depths necessitate use of Box Type E. Shallow above-grade slabs necessitate use of Poke-Through Outlet. Conduits shown on plans are minimum size; select appropriate floorbox based on slab type, thickness, and minimum conduit size.

MFR	CAST IRON BOX	STAMPED STEEL BOX	COVER PLATE	CARPET TRIM	COORDINATION
Steel City	600 2SC(accepts up to (4) 2" conduits)	68 D (accepts up to (4) 1" conduits)	P60-DS or P60-1/2-2 for Furniture Feeds	P60-CP	Coordinate with Owner/Telecommunications installer – requires that they install Duplex Insert for floor outlets.
Wiremold	889B (accepts up to (2) 1-1/4" conduits)	886B (only accepts (1) 1" conduit)	895GFI (Carpet) / 895TGFI (Tile) or 896CK	n/a	Coordinate with Owner/Telecommunications installer –

			(Carpet) / 896TCK-1 (Tile) for Furniture Feed		requires that they install Decora Insert for floor outlets
Hubbell	For 4" slabs – B253641 (accepts up to (4) 1" conduits) For 4.75+" slabs, B2506 (accepts up to (4) 1-1/4" conduits)	For 4" slabs only – B2527 (accepts up to (1) 1-1/4" conduit and (1) 1" conduit)	S3925 or S2725 for Furniture Feed	S3182	Coordinate with Owner/Telecommunications installer – requires that they install Duplex Insert for floor outlets.

3. **Box Type E - Multi-Service (2 compartment):** For slab on grade: watertight, Class 1, fully adjustable, cast iron. For slab above grade: concrete-tight, Class 2, fully adjustable, stamped galvanized steel. Two compartments - one side plate with knockouts for communications faceplate and connectors; one side plate with provisions for one duplex receptacle. Furnish polycarbonate or nylon cover and flange piece with standard color as directed by Contract Administrator. Conduits shown on plans are minimum size; select appropriate floorbox based on slab type, thickness, and minimum conduit size. Shallow above-grade slabs necessitate use of Poke-Through Outlet.

MFR	CAST IRON BOX	STAMPED STEEL BOX	RECEPTACLE PLATE	BLANK PLATE	COVER
Steel City	664-CI (accepts (3) 1" conduits in Communications compartment)	664	664-RP, 664-GP (Decorator Style)	664-BP	664-CST Series
Wiremold	RFB2-OG	RFB2-SS	RFB2DP, RFB2B (Decorator Style)	RFB2B	FP Series
Hubbell	3SFBC (accepts (1) 1-1/4" conduit in Communications compartment)	3SFBSS (accepts (1) 1" conduit in Communications compartment)	3SFBRP, 3SFBDS (Decorator Style)	3SFBB	3SFBCxxA Series

C. Poke-Through Outlets (Multi-Service)
1. General
   a. Provide a complete Poke-Through Assembly.
   b. Assembly shall be UL listed and UL Fire Classified, flush type, with one- to four-hour fire rating, as required by floor rating and type.
   c. Poke-through used for power: Electrical receptacle(s) shall be provided per Division 26 Section "Wiring Devices" or as indicated on the Drawings. Refer to Electrical Drawings and Division 26 Specifications for receptacle types, quantities and colors. Unless otherwise noted, all floor boxes shall contain electrical power receptacles. If no requirements are listed elsewhere, provide a minimum of one normal 20A, 125V NEMA 5-20R duplex receptacle.
   d. Poke-through utilized for communications: Include provisions for mounting communications faceplate and connectors in accordance with the requirements of the communications systems provider.

2. Type A – Flush: Dual Service for Power and Telecommunications only, with outlets flush in the floor
    a. Capable of supporting, at a minimum, a duplex 20A/125V receptacle (or equivalent), and one decora style opening / mounting plate for telecommunications.
    b. Coordinate cover type and color with Contract Administrator.
    c. Manufacturer shall be:
        1) Wiremold 6ATC Series with 6DEC Mounting Plate.
        2) Hubbell S1PT Series
3. Type B – Furniture Feed: Dual Service for Power and Telecommunications only, with cables to extend through flexible conduit into modular furniture.
    a. Poke Thru and cover plate shall support 3/4" trade size screw plug opening for electrical and 1-1/4" trade size screw plug opening for telecommunications.
    b. Coordinate cover finish with Contract Administrator.
    c. Manufacturer shall be:
        1) Wiremold 6ATCFF Series
        2) Hubbell S1PTFF Series

D. Access Doors for Communications Systems
1. Refer to Execution section for location requirements.
2. Refer to Division 26, "Common Work Results for Electrical" for specific product and material information.

E. Fire stop System Assemblies for Communications Systems
1. General
    a. Communications cable tray shall not continue through a fire-rated wall. Stop the tray, install multiple Fire-Rated Pathway Devices for Communications (capacity shall match that of cable tray cross-sectional area), and continue tray on the other side. Ensure grounding of the tray is continuous through the wall.
    b. Minimum performance requirements: Shall meet testing requirements of ASTM E-814 or U.L. 1479; Shall be installed in accordance with the NRTL. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.
    c. Shall be a pre-fabricated and zero-maintenance solution which requires no action to activate the fire and smoke protective characteristics of the device.
2. Fire-Rated Pathway Device for Communications - for sleeves through a single penetration (wall or floor)
    a. Allows the installation and removal of cables without the need to remove or add any materials.
    b. Used to seal penetrations of cables through fire rated partitions.
    c. Manufacturer shall be:
        1) EZ-Path family of products by Specified Technologies Inc.
        2) Or equivalent from Conditionally Approved manufacturer.
3. Through-Floor Firestopping Sleeve for Communications
    a. Used to seal penetrations of cables through fire rated floor.
    b. Manufacturer shall be:
        1) EZ-Path Series 44
4. Firestopping for Communications Backboxes in Fire-Rated Walls
    a. Specifications
        1) Used to seal communications backboxes in fire rated partitions.

2) Minimum performance requirements: Shall meet UL testing requirements of UL 263 and classified as Wall Opening Protective Material (QCSN or CLIV); Shall be installed in accordance with the NRTL. Shall meet or exceed the ratings of the wall or floor that it is located in.
3) Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.

b. Manufacturer shall be:
1) Specified Technologies Inc., SpecSeal Power Shield
2) Or equivalent from
a) 3M
b) Hilti

5. Firestopping for Thru-Wall (or Floor) Communications Conduit Penetrations and Other Applications
a. For fire-rated penetrations where the pathway extends beyond a single fire-rated partition/floor, and other required firestopping applications required by Communications Pathways not previously addressed in this specification.
b. Specifications:
1) Shall be UL listed for the specific application;
2) Shall meet or exceed the ratings of the wall or floor that it penetrates.
c. Manufacturer shall be:
1) Specified Technologies Inc., SpecSeal Power Shield
2) Or equivalent from
a) 3M
b) Hilti

2.02 TELECOMMUNICATIONS BACKBOARD

A. Telecommunications Backboard
1. A minimum of one wall shall be covered with 0.75 in (19 mm) plywood, UON on drawings.
2. The backboard shall be 4 ft (1.2 m) x 8ft (2.4 m) sheets, mounted vertically, with the bottom of the plywood mounted 6 in (150 mm) above the finished floor with the best side toward the room.
3. Plywood shall be A/C grade and finished with two coats of fire-retardant paint.
4. Plywood shall be painted prior to installation of any equipment; mask out one stamp on each sheet of plywood prior to painting.
5. Plywood shall be permanently fastened to the wall by means of wall anchors utilizing galvanized, zinc plated, or stainless steel hardware with a flat head. Finished installation shall have flush appearance with countersunk screw heads to prevent splitting of the plywood. Drywall screws are not acceptable.

2.03 BONDING AND GROUNDING (EARTHING)

A. General
1. Provide a complete functioning telecommunications grounding and bonding system, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary for the system to be in compliance with the ANSI/TIA-607 Standard "Generic Telecommunications Bonding and Grounding for Customer Premises". Major components include:

a. PBB in the Entrance Facility and SBBs in all remaining Telecommunication Rooms and Spaces.
b. TBC connecting the PBB to the main Electrical Service Ground.
c. TBB connecting the PBB to all SBBs.
d. All equipment and pathway grounding and bonding connections as identified on the drawings, recommended by manufacturers of equipment installed under this section, and stipulated in the referenced standard.

2. Available Component Manufacturers:
   a. Chatsworth
   b. Cooper B-Line
   c. Erico
   d. Harger
   e. Hoffman
   f. Panduit
3. Conductor Manufacturers
   a. Shall be from the list of Component Manufacturers; or
   b. Shall be from the list of Manufacturers in Division 26 Section “Low-Voltage Electrical Power Conductors and Cables”.

B. Primary Bonding Busbar (PBB)
1. Specifications
   a. All busbars shall have a clear cover installed to protect connections
   b. Cover shall be:
      1) Plexiglass or plastic
      2) Cover shall be printed with 3/8” lettering “PBB” using appropriate labels.
      3) Of the same manufacturer as the ground bar
   c. A predrilled Electrotin plated copper busbar provided with holes for use with standard sized lugs; hole patterns shall be in TIA/BICSI style.
   d. Have minimum dimensions of 1/4 inch thick x 4 inches wide x 20 inches long.
   e. Provide enough length for all connections with 25% growth.
   f. Provided with insulators to electrically isolate busbar from mounting surface.
   g. Provided with a minimum of 2-inches clearance from wall or other mounting surfaces for access.
2. Manufacturer shall be
   a. Harger TGBIP14420TMGB
   b. Chatsworth 40153-020
   c. Or equivalent from Component Manufacturer

C. Secondary Bonding Busbar (SBB)
1. Specifications
   a. Be a predrilled Electrotin plated copper busbar provided with holes for use with standard sized lugs
   b. Have minimum dimensions of 1/4 inch thick x 2 inches wide x 12 inches long
   c. Provided with insulators to electrically isolate busbar from mounting surface
   d. Provided with a minimum of 2-inches clearance from wall or other mounting surfaces for access.
2. Manufacturer shall be
   a. Harger TGBI14212TGB
   b. Chatsworth # 13622-012

c. Or equivalent from Component Manufacturer

D. Ground Wire for TBB
1. Specifications
a. All grounding and bonding connectors shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as required by the NEC.
b. All grounding and bonding conductors shall be copper and may be insulated UON. When conductors are insulated, they shall be listed for the application (i.e. Plenum, riser, outside plant, etc.)
c. Ground Wire for TBB: Non-Insulated grounding wire with a minimum conductor size as indicated on drawings. Wire shall be UL listed.
d. Cable jacket marking: Shall be legible and shall contain the following information:
1) Manufacturer's name.
2) Copper Conductor Gauge.
3) UL listing.
e. Cable jacket shall be green with black lettering.
f. Sizing shall be per Part 3 of this section. All sections of TBB longer than 300 feet shall be 750 kcmil.

E. Bonding Conductor (To main Electrical service ground) for Telecommunications (TBC): Insulated grounding wire [with a minimum copper conductor size equal to that of the TBB], with PVC insulation. Shall be UL listed.
1. Specifications
a. Copper.
b. Insulated grounding wire with PVC insulation
c. A minimum copper conductor size equal to that of the largest TBB or other bonding conductor connected to the PBB, UON.
d. Cable jacket marking: Shall be legible and shall contain the following information:
1) Manufacturer's name
2) Copper Conductor Gauge
3) NRTL listing information
e. Cable jacket shall be green with black lettering
f. A minimum conductor size as indicated on drawings

F. Ground Wire (for connections within each Telecommunications Room and to Cable Tray)
1. Specifications
a. Copper.
b. When not routed through plenum or other air-handling space: Insulated grounding wire with a minimum copper conductor size of number 6 AWG, with PVC insulation. Shall be UL listed.
c. When routed through plenum or other air-handling space: Non-Insulated grounding wire with a minimum copper conductor size of number 6 AWG. Shall be UL listed.
d. Cable jacket marking: Shall be legible and shall contain the following information:
1) Manufacturer's name.
2) Copper Conductor Gauge.
3) UL listing.
e. Cable jacket shall be green with black lettering.

G. Connectors / Connections
1. Specifications

a. All connectors and connections shall utilize products that are Listed by a NRTL such as UL.
b. All connectors shall have twin clamping elements for cable; two holes for attachment to grounding bar, etc.

2. Compression Lugs
   a. Specifications
      1) Shall be manufactured from electro-plated tinned copper for use with copper conductors.
      2) Shall include inspection port.
      3) On center dimension between holes (O.C. Dim. B/T Holes) shall be 0.625" ("A" Pattern) or 1" ("C" Pattern)
   b. Manufacturer shall be:
      1) Harger GECLB Series
      2) Or Approved Equivalent
3. Conductor to conductor connection
   a. Specifications
      1) All connections between conductor and the joining or mating of cables to connectors shall be done by exothermic weld or irreversible compression connector.
   b. Manufacturer – Exothermic Weld
      1) Erico CADWELD
      2) Harger Ultraweld
      3) Or Approved Equivalent
   c. Manufacturer – Irreversible Compression connector
      1) Burndy HYGROUND
      2) Or Approved Equivalent
4. Connector for conduit to cable
   a. Specifications
      1) All continuous conduits (except entrance conduits) which extend into the Telecommunications Room shall be fitted with a pipe clamp or conduit bonding clamp connected to the PBB/SBB.
   b. Manufacturer shall be:
      1) For 1" diameter and larger conduits – Harger series CPC electro tin-plated pipe lamp
      2) For less than 1" diameter conduits – Harger TBGC4SCS elctro tin-plated conduit bonding clamps
      3) Or Approved Equivalent

H. Insulated Grounding Bushings
   1. Specifications
      a. All communications entrance conduits that extend into the Telecommunications Room shall be fitted with an Insulated Grounding Bushing.
      b. Shall be UL Listed for copper conductors.
      c. Shall include lug for easy connection of conductor to PBB/SBB.
   2. Manufacturer shall be:
      a. O-Z/Gedney IBC-L
      b. Or Approved Equivalent

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.02 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. General
1. Unless otherwise noted, pathway routing shown on the Drawings is illustrative only and meant to indicate the general configuration of the work. Install pathways so that adequate clearances and offsets between pathways and other trades are provided. Coordinate all pathways with other trades prior to installation.
2. Permanently mark or tag each raceway at intervals of not more than 75 feet (22.86 m), and each junction box and pull box. Permanently mark or tag each raceway that is stubbed into the ceiling space from an outlet box. Identifying them as "TELECOM" or "AV" as appropriate.
3. Coordinate the following with cable-installing contractor.
   a. All supports shall be specifically designed to support the required cable weight and volume. Field manufactured supports will not be accepted.
   b. All pathways shall include empty space for a minimum of 25% growth beyond initial installation of cabling.
   c. Provide all communications pathways:
      1) So that cables are allowed to be pulled in accordance with referenced standards and guidelines.
      2) So that cables are allowed to be pulled without damage to conductors, shield, armor, or jacket.
      3) So that cables are not forced or allowed to exceed minimum allowed bend radius by manufacturer or referenced standards and guidelines
      4) So that the maximum allowable pulling tension is not exceeded
      5) To meet the requirements of the structure and the requirements of all other Work on the Project.
      6) Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Contract Administrator.
      7) Parallel or perpendicular to building lines or column lines.
      8) When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
   d. Follow manufacturer's recommendations for allowable fill capacity. Do not exceed load ratings specified by manufacturer.
4. Access to pathways and associated equipment
   a. Care shall be taken to ensure that other building components (e.g., air conditioning ducts, pipes, conduits) do not restrict access. Locate all cable trays, open hanger cable supports, j-hooks, pull boxes, junction boxes and fire stopping systems so as to provide easy access for operation, service inspection and maintenance.
   b. Provide an access door where equipment or devices are located above inaccessible ceilings.

c. Pathways requiring access such as open hanger cable supports, j-hooks, and cable trays shall have an access door or other means of direct access at a minimum of 10 feet (3 m) intervals.
d. Cables or cable pathways requiring access such as open hanger cable supports, j-hooks, and cable trays may not change directions above an inaccessible ceiling unless complete access to the change of direction in pathway or cable route is within arms reach 3 feet (0.9 m) from adjacent accessible point.

B. Conduits and Backboxes for Communications
1. Bond and ground all metallic conduits and boxes in accordance with national or local requirements and owner Standards (if applicable).
2. Ream all conduit ends and fit them with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
3. Conduits which enter telecommunications rooms shall extend 1 inch (25.4 mm) to 3 inches (76.2 mm) AFF.
4. Flexible conduits may only be used where specifically allowed by these contract documents.
   a. Flexible conduit sections shall be less than 20 feet (6.1 m) in length and shall be increased by (1) trade size
5. No continuous section of a conduit may exceed 100 feet (30.5 m) without a pullbox.
6. Conduit runs shall not exceed a total of 150-feet (45.7 m).
7. No more than (2) 90° bends, or equivalent will be allowed between pullboxes.
   a. Each and any offset shall be considered a 90° bend.
   b. A pullbox is required wherever a reverse bend is installed.
8. The minimum bend radius for conduits is
   a. (6) times the inside diameter for 2 inches (50.8 mm) conduits or less.
   b. (10) times the inside diameter for conduits greater than 2 inches (50.8 mm).
9. Install a pull cord in each pathway (empty or not) for installation of new wires or cables. Use polypropylene or monofilament plastic line with not less than 200 lb (90.7 kg) tensile strength. Leave at least 12 inches (304.8 mm) of slack at each end of pull cord.
10. Provide appropriately sized sleeves where cables are required to pass through non-rated full-height partitions. Rated partitions shall be provided with appropriately rated firestop systems. Where allowed, sleeves shall extend a minimum of 3 inches (76.2 mm) beyond the partition surface on both sides, and shall be rigidly supported to support the weight of cables. Sleeves shall be sized so that no more than 50% of the cross-sectional area is utilized by the cabling to be installed. The minimum inside diameter of each sleeve shall be nominal 2 inches (50.8 mm).
11. PullBoxes
    a. Pullboxes shall be placed in Conveniently Accessible locations.
    b. Coordinate the location and installation of all pullboxes to ensure adequate access is provided.
    c. Pullboxes above an accessible ceiling shall:
       1) Be aligned directly over the ceiling grid to allow access
       2) Be installed with a minimum of 3 inches (76.2 mm) clearance to ceiling grid and tiles
    d. No directional changes shall be allowed in pullboxes. Conduit Shall continue in the same direction as it enters and then change direction via an appropriately sized bend in the conduit.
    e. Size pullboxes according to the following chart:

Conduit Trade Size	Width	Length	Depth	Width Increase for Additional Conduit (of same size)
¾" or smaller	4"	4"	2-1/8"	Not applicable
1"	4"	16"	3"	2"
1-1/4"	6"	20"	3"	3"
1-1/2"	8"	28"	4"	4"
2"	8"	36"	4"	5"
2-1/2"	10"	42"	5"	6"
3"	12"	48"	5"	6"
4"	16"	60"	8"	6"

12. Provide an empty EMT raceway from each outlet box into the ceiling space above and terminate with a nylon bushing. In rooms with a non-accessible ceiling, install raceways to the nearest accessible corridor ceiling or as indicated on the Drawings.
13. No outlet boxes shall be located back-to-back in a wall cavity.
    a. Where possible offset to next stud cavity, but no less than a 6 inches (152.4 mm) separation.
14. Outlet boxes shall be within 3 feet (0.9 m) of nearest electrical outlet.
15. Provide appropriate plaster/mud ring as indicated on the drawings.
16. Provide conduit as indicated on the Drawings or required by this Specification. Minimum communications conduit size shall be 1 inch (25.4 mm). Provide a polypropylene or monofilament plastic line with not less than 200-lb (90.7 kg) tensile strength in each empty conduit. Permanently mark or tag each conduit or pull box, identifying it as Communications, at intervals of not more than 75 feet (22.9 m). Each conduit that is stubbed into the ceiling space from an outlet box shall be permanently marked or tagged.

C. Fire stop System Assemblies for Communications Systems
1. Provide systems as identified on the drawings and specified herein. At locations where the cabling routing encounters a fire-rated barrier provide an adequately sized fire stop device for the quantities and types for all cables to be installed plus 25% growth.
2. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall, floor or ceiling penetrations; including membrane penetrations. All materials shall be classified or listed as a complete system by approved NRTL by the AHJ and meet NEC and local codes. The use of partial systems or components of systems is not allowed unless specifically identified in the documents.
3. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of smoke, flame, toxic gas or water through the penetration before, during or after a fire. The fire rating (F and T) of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by referenced building codes and National Electric Code.
4. Provide a label on both sides of fire rated assembly at all fire stop locations indicating:
    a. Fire stop Manufacturer
    b. Installer and company
    c. Date installed
    d. UL system number with all relevant ratings indicated

3.03 TELECOMMUNICATIONS BACKBOARD

A. Mount Telecommunications Ground Bars (PBB and SBBs) to telecommunications backboard.

3.04 GROUNDING AND BONDING INSTALLATION

A. General:
1. Install all other ground conductors (wire) without splices or mechanical couplers installed between the wire points of origin and termination except as shown on the Drawings and/or specified herein. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in Telecommunications rooms (spaces). Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage. “Daisy chaining” of Telecommunications ground bus bars back to the PBB will not be accepted unless specifically indicated on the Telecommunications drawings or specified herein
2. Unless otherwise noted, all ground wires shall be routed through the Telecommunications cable management pathways so as to achieve a “coupled bonding conductor” effect
3. Where insulated conductors are necessary provide adequately rated insulation jackets or pathways to meet all required building codes. (I.e. Plenum, riser, outside plant, run entirely in conduit, etc.)
4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds 3 feet (1 meter) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum.
5. The Telecommunications Bonding Conductor (TBC), each Telecommunications bonding backbone (TBB) conductor, and each Backbone bonding conductor (BBC shall be green or marked with a distinctive green color.
    a. Marking with a distinctive green color Shall be done at a minimum of every 1 foot (0.3 meter) by appropriate methods.
    b. Indicate proposed and actual routing of these conductors on overall floor plans in both the pre-construction Shop Drawings and Record Drawings, respectively.
6. Follow additional installation requirements from NECA/BICSI 607-2011 “Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings”.

B. Required Grounding Connections:
1. Provide and install one individual ground wire from each equipment rack/cabinet/frame (installed under this work) to the SBB in the room. Each conductor is to be “home run”; do not “daisy chain” the connections, except as may be indicated on the drawings.
2. Provide and install one individual ground wire from the raised floor system (if applicable) to the PBB. Conductor is to be “home run”; do not “daisy chain” the connections, except as may be indicated on the drawings.
3. Provide and install one individual ground wire from the overhead and vertical ladder racking (installed under this work) to the SBB in the room. All sections of ladder rack shall be securely connected together; otherwise, provide ground wire from each section of ladder rack.
4. Where structural steel is available for connection install one individual ground wire to the nearest structural steel for connection.
5. Provide and install all grounding connections as required by Telecommunications set of drawings.

C. Connector Installation:

1. Provide all ground wire connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
2. Follow the connector manufacturer's instructions for installing the connector to the cable and the connector to the cabinet/rack, ground bar, etc. Use the appropriate tools for the job, tighten nuts/bolts to proper torque, remove paint, insulation, oxidation as needed to assure good metal to metal contact, etc. If the manufacturer does not provide tightening specifications, follow the recommendations of UL Standard 486.

D. Cable Identification:
1. Label both ends of each ground conductor within 6 inches (152.4 mm) of a connector terminal or splice. Label the grounding conductors as shown on the Drawings or specified herein. All labels shall include the following in addition to specific labeling requirements for each conductor.

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER

E. Quantities of Ground Wires (Conductors)
1. Location and placement of grounding and bonding wires and components shall be as shown on the Drawings or defined herein.
2. Quantities of ground wires, bonding components, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of materials to construct a grounding and bonding system that meets the intent of these Specifications and the relevant codes.

F. Sizing of Ground Wires (Conductors)
1. Subject to the applicable electrical code and the reference standards and guidelines, the TBC, TBB, BBC conductors (if applicable), and conductors to serving electrical panels and building steel shall be sized per the following table (Table 1 from ANSI/TIA-607):

Linear Length (ft)	AWG Size
less than 13	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0
67-84	3/0
85-105	4/0
106-125	250 kcmil
126-150	300 kcmil
151-175	350 kcmil
176-250	500 kcmil
251-300	600 kcmil
Greater than 301	750 kcmil

G. Testing
   1. As a minimum test, as described below, all metallic wires and cables installed under these Specifications.
   2. Test the grounding conductor and the terminal connectors for total resistance between the equipment item being grounded and the main telecommunications grounding point in the room. This resistance Shall be less than 0.10 Ohm.
   3. Recommended test equipment (obtain approval of Owner/ Design Consultant prior to using substitute test equipment):
      a. An ohmmeter capable of indicating resistance down to 10 milli-ohms or below.

H. Acceptance
   1. Upon receipt of the Contractor's documentation of cable testing, the Owner/ Design Consultant will review/observe the installation and randomly request tests of the cables/wires installed. Once the testing has been completed and the Owner/ Design Consultant is satisfied that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.

I. Record Drawings
   1. The Project Record Drawings shall show the types and locations of installed grounding and bonding conductors.

END OF SECTION 260510

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Conductors, cables, and cords rated 600V and less.

B. Connectors and terminations rated 600V and less.

1.02 DEFINITIONS

A. The following abbreviations apply to this and other Sections of these specifications:
   1. MC: Metal Clad
   2. NBR: Acrylonitrile-butadiene rubber
   3. NETA ATS: Acceptance Testing Specification.

B. The following definitions apply to this and other Sections of these Specifications:
   1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard.
      a. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop and temperature deration.
   2. Coordinate routing of power, low-voltage, and control conduits requiring fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system for power, low-voltage, and control circuit conductors and cables shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
      a. Feeders for Emergency Power systems where in areas not protected by an automatic fire suppression system.
      b. Smokeproof Enclosure Pressurization systems
      c. Smoke Control systems
      d. Smoke Removal systems
      e. Fire service and Occupant Evacuation Elevator systems
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

4. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

B. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Provide products listed and classified by Underwriters Laboratories, Inc (UL) as suitable for the purpose specified and indicated.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

D. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NFPA 70.

1.05 PROJECT CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Contract Administrator and obtain direction before proceeding with work.

B. 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 Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner’s written permission.
3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.

C. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.07 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 PRODUCTS AND MATERIALS

2.01 CONDUCTORS AND CABLES - GENERAL

A. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable.
   1. Solid conductors for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger

B. Conductor Material: Compact stranded, aluminum alloy (AA-8000 Series), complying with ICEA S-95-658/NEMA WC70; No. 2 AWG or larger only

C. Conductor Insulation: Type THHN/THWN-2 and/or XHHW-2 complying with ICEA S-95-658/NEMA WC70.

D. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).

E. Conductors shall not be smaller than No. 12 AWG, with the exception of wiring for signal and pilot control circuits.

F. Conductors installed for site electrical work shall be no smaller than No. 10 AWG CU. All site electrical branch circuit wiring shall be sized such that the maximum branch circuit voltage drop is less than 3 percent.

G. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.

H. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

2.02 SINGLE CONDUCTORS

A. Available Manufacturers:
   1. Alan Wire
   2. Cerrowire
   3. Colonial Wire & Cable Co., Inc.
   4. Encore Wire Corporation
   5. General Cable (Prysmian Group)
   6. Northern Cables Inc.

7. Okonite Company
8. Southwire Company

B. 600V, insulated conductors as noted above shall be color-coded as follows, unless noted otherwise:

PHASE	120/240V	240Δ/120V	208Y/120V	480Y/277V
A	Black	Black	Black	Brown
B	Red	Orange	Red	Orange
C	N/A	Red	Blue	Yellow
Neutral	White	White	White	Gray**
Equipment Ground	Green	Green	Green	Green
Isolated Ground	N/A	N/A	Green/Yellow Stripe	Green/Yellow Stripe

**Except as provided in NFPA 70.

2.03 TWO-HOUR FIRE RESISTIVE CABLES (INDIVIDUAL CONDUCTORS).

A. Manufacturers:
1. Radix Wire & Cable (DuraLife)

B. Certified to UL2196 for Two-Hour Fire Resistive Cable.

C. Cable shall be NFPA 70 compliant for use in a listed fire-resistive cable assembly and must be installed in a system meeting Electrical Circuit Integrity System (FHIT) No. 28C or 28E of the UL Fire Resistance Directory.

D. Two-hour Certified for both vertical and horizontal installations.

E. Conductors: Stranded soft-drawn copper, Thermal/fire barrier tape, silicone inner layer, LSZH XLPO outer layer, Rated 90 degree C.

2.04 METAL CLAD CABLE; TYPE MC

A. General:
1. Shall be used as indicated on the drawings only.

B. MC Cable (with insulated green grounding conductor, no bonding conductor):
1. Manufacturers:
   a. Atkore/AFC Cable Systems
   b. Cerrowire
   c. Encore Wire Corporation (MC)
   d. Kaf-Tech
   e. Northern Cables, Inc.
   f. Southwire Company (Amorlite)
2. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and NFPA 70. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

3. Armor Assembly: Aluminum interlocked armor (aluminum color).
4. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
5. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NFPA 70.
6. Marking: Cable markings shall comply with the requirements of NFPA 70.

C. MC Cable Fittings:
1. Manufacturers:
   a. ABB/T&B
   b. Arlington
   c. Eaton/Crouse-Hinds
   d. Emerson/O-Z Gedney
2. Fittings used for connecting Type MC cable to boxes, cabinets, or other equipment shall be UL listed and identified for such use with an MCI-A marking on the fitting carton or package.
3. Fittings shall be insulated type not requiring the use of anti-short bushings.
4. Romex style, clamp type fittings are not acceptable.

2.05 FLEXIBLE CORDS

A. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant [black][yellow] jacket, extra-hard-usage; Type SEO, SO, or STO for indoor dry and damp locations; SEOW, SOW, or STOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.

2.06 CONTROL WIRING

A. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

2.07 CONNECTORS

A. Available Manufacturers:
1. AMP; Tyco
2. FCI-Burndy
3. Gould
4. Ideal Industries, Inc.
5. Ilsco
6. NSi Industries, Inc.
7. O-Z/Gedney
8. Panduit
9. Thomas and Betts
10. 3-M Electrical Products Division

B. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, circumferential compression type (Burndy "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.

1. Termination fittings for copper conductors: Bare copper, 1-hole pad and inspection port.
2. Termination fittings for aluminum conductors: Tinned aluminum, 1-hole pad.

C. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
1. Termination fittings: Bare copper, 1-hole pad and inspection port.
2. Termination fittings: Tinned aluminum, 1-hole pad.

D. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.

E. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: flanged fork-tongue type.

F. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.

G. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

H. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)

B. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.

C. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).

D. Where anticipated conductor installed lengths exceed the lengths indicated on the Drawings, notify Contract Administrator. Provide tabulated list of exceeded lengths for review. Increase conductor size, circuit ground size, and conduit size accordingly to meet maximum voltage drop indicated within the calculations.

3.02 INSTALLATION

A. General
1. Unless otherwise indicated on the Drawings on in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 12 inches of conductor at outlets for fixture or device connections.
2. Install in accordance with manufacturer's instructions.
3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
4. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
5. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
6. Seal around cables penetrating fire-rated elements according to Division 26, Common Work Results For Electrical.
7. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
8. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
9. Multi-wire branch circuits are not allowed unless noted otherwise on the drawings.
10. Where multi-wire branch circuits are utilized (i.e., shared neutral), shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two examples.
11. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
12. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
13. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:
    a. Normal or Non-Essential circuits.
        1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
        2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
        3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
    b. GFCI-protected circuits.
        1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.
    c. Isolated Ground (IG) Circuits:
        1) Do not use multi-conductor or MC cables.
        2) Do not share neutrals between separate circuits.

3) Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
4) The equipment grounding conductor may be shared between IG circuits sharing a common raceway.

14. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
15. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
16. Branch circuit conductors shall be copper.
17. All essential power systems circuits shall be copper.
18. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:
    a. Wet or dry locations, in raceways:
        1) Service entrance: Type THWN, THHN/THWN-2, or XHHW-2.
        2) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW-2.
        3) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.
        4) Conductors used between a variable frequency drive (VFD) and associated motor: Type XHHW-2.
    b. Fluorescent light fixtures or conductors within three feet of high temperature equipment such as heaters: Type THHN, XHHW, or higher temperature insulation as required for the use.

B. Aluminum Conductor Option:
1. Terminations: Tinned, mechanical type only; UL-listed for copper and aluminum conductors at 75 degrees C minimum.
2. Increase the raceway size as required, at no additional cost to the Owner, to accommodate the increased size of the aluminum conductors.
3. Aluminum conductor size shall meet or exceed the ampere rating of the scheduled copper conductors at 75 degrees C.
4. Aluminum option applies only for the following feeders or services with minimum size as indicated in “Conductors and Cables” materials section above. All feeders and services smaller than the minimum size or those not listed below shall be copper:
    a. Service and feeder conductors may be aluminum unless prohibited below.
        1) Exceptions:
            a) Feeders connecting directly to motors including, but not limited to, chillers and fire pumps shall be copper to minimize loosening of connectors due to cyclical thermal expansion.
    b. Service entrance conductors
    c. Feeders to switchboards
    d. Feeders to panelboards
        1) Exception: Apartment unit load center feeder conductors shall be copper; aluminum is not acceptable.
    e. Feeders to motor control centers
    f. Feeders to transformers
5. Where aluminum conductors terminate existing panelboards, switchboards or switchgear that utilize compression connections use hydraulic-compression type connectors with a

zinc base, anti-oxidizing compound. Use compression tools of the type that will not release unless the correct pressure has been applied.

6. Measure the temperature of all aluminum conductors at all splices and terminations. Make each test under typical building load conditions after the building is occupied and in operation for a minimum of two weeks. Replace all joints or splices indicating excessive heating.
7. Take measurements with a non-contact type infrared thermometer, with target size not exceeding one inch at five feet and an accuracy of two percent or better. Submit the meter specifications and calibration date with the test results.

C. Metal Clad Type MC Cable:
1. Securing and Supporting:
   a. Support per NFPA 70 for MC cable
   b. Secure cable within 12 inches of every box or fitting.
   c. Secure/supporting intervals shall not exceed six (6) feet for MC cable.
   d. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible so as to provide for cable routing in a neat and workmanship like manner.
2. Type MC cable may only be used:
   a. In lieu of flexible conduit and wiring from light fixtures in accessible ceilings to junction boxes (attached to building structure) above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.
3. MC cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
   a. Unjacketed MC:
      1) In locations not permitted by NFPA 70.
      2) When specifically not allowed by the local AHJ.
      3) Homeruns to panelboards.
      4) Where exposed to view.
      5) Where subject to physical damage.
      6) Corrosive or Hazardous locations.
      7) Wet locations.
      8) Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
      9) Within mechanical, electrical or telecommunication equipment rooms.

D. Flexible Cords
1. Refer to Division 26 Section, “Equipment Wiring Systems”, for electrical connections to equipment.

E. Control Wiring
1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or otherwise specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.

a. Low voltage wiring not routed in a race way shall be supported by cable tray or j-hooks secured independently of ceiling supports. Cabling shall not be supported directly by the ceiling system.

F. Connections:
1. Apply a zinc based, anti-oxidizing compound to connections.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
4. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
5. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.
6. Use connectors as indicated in equipment schedules. Where not indicated use connections as noted below.
   a. Compression – Conductors No. 8 AWG and larger to panelboards, switchboards and apparatus
   b. Compression – splices, terminals
   c. Mechanical – where temporary removal is required
7. Do not use terminals on wiring devices to feed through to the next device.

3.03 IDENTIFICATION

A. General: Provide all identification per Division 26 “Identification for Electrical Systems”.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. This Section includes:
1. Grounding Electrodes
2. Ground Bars
3. Grounding Conductors
4. Connector Products
5. Equipotential Grounding System
6. Miscellaneous Grounding Materials and Products

1.02 DEFINITIONS

A. The following apply to this and other Sections of these Specifications:
1. Ground ring: Bare underground grounding conductor encircling the building or structure.
2. NETA ATS: Acceptance Testing Specification.
3. PSF: Pounds per Square Foot
4. EMT: Electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. FMC: Flexible metal conduit.
7. GRS: Galvanized Rigid Steel Conduit
8. IMC: Intermediate metal conduit.
9. LFMC: Liquidtight flexible metal conduit.
10. LFNC: Liquidtight flexible nonmetallic conduit.
11. RAC: Rigid Aluminum Conduit
12. RMC: Rigid Metal Conduit
13. RNC: Rigid nonmetallic conduit.

1.03 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

D. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   2. Marked for intended use.
   3. Comply with UL 467.

E. Comply with NFPA 70.

PART 2 PRODUCTS AND MATERIALS

2.01 GROUNDING CONDUCTORS, CONNECTORS, AND ELECTRODES:

A. Available Manufacturers:
   1. ABB, Inc.
   2. Advanced Lightning Technology (ALT)
   3. AFL Global
   4. Boggs, Inc.
   5. Burndy; Hubbell.
   6. Cooper Power; Eaton.
   7. Copperweld Corp.
   8. ECN/Korns; Division of Robroy Industries.
   9. Erico; nVent.
   10. Galvan Industries, Inc.
   11. Greaves Corp.
   12. Harger.
   13. Hastings Fiber Glass Products, Inc.
   14. Heary Brothers Lightning Protection Co.
   15. Ideal Industries, Inc.
   16. ILSCO.
   17. Lightning Master Corp.
   18. Lyncole XIT Grounding; Division of VFC.
   19. O-Z/Gedney Co.; Emerson.
   20. Panduit, Inc
   21. RACO; Hubbell, Inc.
   22. Robbins Lightning, Inc.
   23. Superior Grounding Systems, Inc.

2.02 GROUNDING ELECTRODES

A. Ground Rods: UL-listed:
   1. Copper-clad steel; bonded copper electrolytically-applied to minimum thickness of 10mils.
   2. Size: 3/4 inch by 10 feet. Provide sectional types when longer rods are indicated.

2.03 GROUND BARS

A. General
   1. Ground bars described in this section are intended to be wall mounted bars used for grounding and bonding. Equipment ground buses for switchboards, panelboards and miscellaneous equipment are described in the individual equipment sections.

2. Supports: Minimum of two each 1-1/2-inch insulators and 1-inch stainless steel offset mounting brackets.

B. Telecommunications Main Grounding Busbar (TMGB)
1. Rectangular Ground Bars: UL & cUL Listed to UL467 & C22.2 respectively, pre-drilled per TIA/EIA Standard 607A, bare, 1/4 inch thick, electrolytic, tough pitch copper bar, 4 inches wide. Length as indicated on the Drawings but not less than 24 inches long.

2.04 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

B. Material:
1. Aluminum.
2. Copper-clad aluminum.
3. Copper.

C. Equipment Grounding Conductors: Insulated and identified as indicated in Part 3 of this section.

D. Isolated Ground Conductors: Insulated and identified as indicated in Part 3 of this section.

E. Grounding Electrode Conductors: Bare, stranded, unless otherwise indicated.

F. Underground Conductors:
1. Bare-copper conductor.
2. No. 2/0 AWG minimum
3. Stranded, unless otherwise indicated.

G. Bare Copper Conductors:
1. Solid Conductors: Comply with Conductors: ASTM B 8.
2. Tinned Conductors: Comply with ASTM B 33.

H. Copper Bonding Conductors:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (wide and 1/16 inch thick.

I. Aluminum Bonding Conductors:
1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

J. Ground Ring:
1. Bare copper grounding conductor, size as noted on Drawings but not less than #2/0 AWG.

K. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood molding is utilized, use pressure-treated fir, or cypress or cedar.

2.05 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors.

C. Compression Connectors: Burndy Hyground, or equal, permanent, pure, wrought copper, meeting ASTM 8 1 87, essentially the same as the conductors being connected; clearly and permanently marked with the information listed below:
   1. Company symbol and/or logo.
   2. Catalog number.
   3. Conductors accommodated.
   4. Installation die index number or die catalog number is required.
   5. Underwriters Laboratories “Listing Mark:”.
   6. The words “Suitable for Direct Burial” or, where space is limited, “Direct Burial” or “Burial” per UL Standard ANSI/UL467.

D. Cast connectors: copper base alloy according to ASTM B 30.

E. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Contract Administrator and the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of NFPA 70 and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.
   2. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.
   3. Where the size of the grounding conductors are not shown, size in accordance with NFPA 70 Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Application:
   1. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
   2. Underground Grounding Conductors: Unless noted otherwise, bury at least 24 inches below grade, or 6 inches below the official frost line, whichever is greater, or when crossing a duct bank, bury 12 inches above duct bank.

C. Grounding Electrode System: Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
   1. Provide continuous grounding electrode conductors without splice or joint.
   2. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   3. Ground Rod Electrodes:
      a. 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.
      b. Unless otherwise indicated, install ground rod electrodes vertically.
         1) Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
         2) Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
      c. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70. If depth is unachievable, notify Contract Administrator and Engineer.
      d. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
      e. Verify that final backfill and compaction has been completed before driving rod electrodes.
      f. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade, pavement, or floor.
   4. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches. Use exothermic weld to secure grounding electrode conductor.
   5. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   6. Metal In-Ground Support Structures: Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   7. Metal Poles Supporting Outdoor Luminaires: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

D. Equipment Grounding Conductors:
   1. Comply with NFPA 70, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

2. Install equipment grounding conductors in all feeders and branch circuits.
3. Install equipment grounding conductor with circuit conductors for the following items, in addition to those required by NFPA 70:
    a. Feeders and branch circuits.
    b. Lighting circuits.
    c. Receptacle circuits.
    d. Single-phase motor and appliance branch circuits.
    e. Three-phase motor and appliance branch circuits.
    f. Flexible raceway runs.
    g. Armored and metal-clad cable runs.
    h. Feeders and branch circuits installed in non-metallic raceways.
4. In branch circuit and feeder raceways, use insulated equipment grounding conductors.
5. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
6. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components. On water heaters, bond metal hot and cold water pipes together, across the heater tank.
7. Busway Supply Circuits: Install an insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panelboard to the equipment grounding bar terminal on the busway, if a direct bus-to-bus connection is not factory provided.

E. Separately Derived Systems: Bond the derived neutral (grounded) conductor of all separately derived system (e.g., transformers, generators, UPS) to the nearest available grounding electrode, or back to the service grounding electrode if no approved electrodes are readily available. Size the grounding electrode conductor and bonding jumpers as indicated on the Drawings or as required by NFPA 70, whichever is larger.

F. Bonding: Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70:
1. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
2. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
3. Bond metallic elements likely to become energized or where indicated on the Drawings, including but not limited to fences around electrical equipment and metal drain bodies near pools or electrical equipment.
4. Bond raised flooring systems and static control flooring.
5. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

6. Pole Mounted Luminaires: Bond metal enclosures and components of pole mounted luminaires to the grounding system per the Manufacturer's requirements.
7. Bond the components within the following systems to the building grounding system:
   a. Metallic Cable Tray Systems.

G. Isolated Ground (IG) Receptacle Circuits:
1. Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
2. Do not use multi-conductor or MC cables.
3. Do not share neutrals between separate circuits.
4. Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
5. The equipment grounding conductor may be shared between IG circuits sharing a common raceway

3.03 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to 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.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Replace welds that are puffed up or that show convex surfaces indicating improper cleaning. Use exothermic welded connections for the following:
1. Connecting conductors together.
2. Connecting conductors to ground rods, except at test wells.
3. Connecting conductors to building steel.
4. Connecting conductors to plates.

C. Mechanical Pressure-Type Connections: Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A[and UL 486B].
1. Mechanical Pressure Fittings: Use bolted mechanical (removable) pressure-type clamps for the following:
   a. Connecting conductors to ground rods at test wells.

b. Connecting conductors to pipes.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 GROUND RING

A. Ground the steel framework of the building with a buried electrode at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Protect taps for steel framing connections from physical damage at foundations and transitions to steel columns.

3.05 EQUIPOTENTIAL GROUNDING SYSTEM

A. Equipotential grounding system shall consist of No. 10 AWG stranded copper conductors connecting all exposed metal objects and metal building surfaces (within 6’-0” beyond the reach of the patient) to the patient grounding point or room bonding point and ultimately to the reference grounding point.

B. The grounding connection between patient grounding points, room bonding points, reference grounding point, isolation power centers, panelboards, etc. shall be a stranded copper conductor sized as indicated on the Drawings. The system shall conform to NFPA 70.

C. Provide an equipotential grounding system in the following areas:
1. Operating Rooms
2. Delivery Rooms
3. Emergency Treatment Rooms
4. Intensive Care Areas
5. Cardiac Care Areas Recovery Rooms
6. Dialysis Units

D. Connect conductive flooring to the room bonding point by means of a No. 10 AWG bare copper conductor extending a minimum of 3’-0” into the room under the flooring.

3.06 OVERHEAD-LINE GROUNDING

A. Comply with IEEE C2 requirements. Use two or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.

B. Drive ground rods to a depth of 12 inches below finished grade in undisturbed earth.

C. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.

D. Lightning Arresters: Separate arrester grounds from other grounding conductors.

E. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.

F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.07 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a 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 tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect 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. 6 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise encircling the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade, or 6 inches below the official frost line, whichever is greater, and 6 inches from the foundation.

3.08 IDENTIFICATION

A. Provide identification as specified in Division 26 “Low-Voltage Electrical Power Conductors and Cables” and “Identification for Electrical Systems”.

3.09 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each 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.
4. Inspect and test in accordance with NETA ATS, except Section 4.
5. Perform inspections and tests listed in NETA ATS, Section 7.13.
6. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
7. Perform point–to–point megohmmeter tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
8. Test Values:
    a. The resistance between the main grounding electrode and earth ground shall be no greater than 10 ohms.
    b. Equipment Rated 500 kVA and Less: 10 ohms.
    c. Equipment Rated 500 to 1000 kVA: 5 ohms.
    d. Equipment Rated More Than 1000 kVA: 3 ohms.
    e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    f. Manhole Grounds: 10 ohms.
9. Minimum system neutral–to-ground insulation resistance: one megohm.
10. Investigate point-to-point resistance values that exceed 0.5 ohms.
    a. Check for loose connections.
    b. Check for absent or broken connections.
    c. Check for poor quality welds.
    d. Consider other reasons.
11. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements
12. Excessive Grounding Electrode Resistance: If measured resistance to earth ground value exceeds specified values, add grounding electrodes and additional conductors as required to obtain the specified value.
13. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.10 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 31 and 32. Maintain restored surfaces. Restore disturbed paving as indicated.

3.11 EXISTING INSTALLATIONS

A. Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Where applicable, verify the neutral and ground are properly bonded at the point of service entrance. Notify the Landlord, Owner and the Engineer of any existing deficiencies.

END OF SECTION 260526

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SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.02 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Contract Administrator of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
   6. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
   7. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Seismic Requirements: Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEP/F/T Systems”.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.
   3. Rooftop support 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 hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
      a. Include strength derating requirements related to ambient temperature.
   4. Equipment supports.

C. Welding certificates.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70 and applicable building code.

B. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.

PART 2 PRODUCTS AND MATERIALS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. General:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly. Use corrosion resistant materials suitable for the environment where installed.
   1. Manufacturers:
      a. Allied Tube & Conduit; Atkore International.
      b. Eaton
      c. Erico; nVent.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Atkore International.
      g. Wesanco, Inc.
   2. Metallic Coatings:
      a. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
   3. Channel Dimensions: Selected for applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder or Battery-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:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Powers Fasteners, Inc;
         5) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Manufacturers:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

2.02 FABRICATED METAL CONDUIT OR EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Unless specifically indicated or approved by the Contract Administrator and Structural Engineer, do not support from roof deck.

C. Where support wires are permitted, identify independent electrical component support wires above accessible ceilings with color distinguishable from ceiling support wires in accordance with NFPA 70.

D. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
   1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
   2. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway:
   1. Minimum rod size shall be 1/4 inch (6 mm) in diameter, unless otherwise indicated.
      a. Equipment Supports: 1/2 inch diameter minimum.
      b. Busway Supports: 1/2 inch diameter minimum.
      c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter minimum.
      d. Trapeze Support for Multiple Conduits: 3/8 inch diameter minimum.
   2. Space supports for EMT, IMC, and RMC as required by NFPA 70.

F. 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:
      a. two-bolt conduit clamps

G. The use of wire rope hanging systems is an acceptable alternate hanging method when installed in strict accordance with manufacturer's instructions. Supported load shall not exceed manufacturer's recommended load rating.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Install in accordance with manufacturer's instructions.

E. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

F. 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).
   1. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.

G. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

H. Do not use products for applications other than as permitted by NFPA 70 and product listing.

I. Remove temporary supports when no longer required.

J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

K. 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.
      a. Instead of expansion anchors, powder or battery-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.
   5. To Steel:
      a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

L. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

D. Minimize overhanging materials and protrusions, and provide protective caps and fittings on exposed material ends where:
   1. Accessible to untrained personnel.
   2. Located within confined spaces.

3.04 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 Division 03 "Concrete"."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Comply with requirements in Division 09 "Finishes" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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

C. Inspect support and attachment components for damage and defects. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes:
   1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.02 DEFINITIONS

A. Terminology used in this specification is as defined below:
   1. EMT: Electrical Metallic Tubing
   2. FMC: Flexible Metal Conduit
   3. GRS: Galvanized Rigid Steel Conduit
   4. IMC: Intermediate Metal Conduit
   5. LFMC: Liquidtight Flexible Metal Conduit
   6. LFNC: Liquidtight Flexible Nonmetallic Conduit
   7. RAC: Rigid Aluminum Conduit
   8. RMC: Rigid Metal Conduit
   9. RNC: Rigid Nonmetallic Conduit
   10. RTRC: Reinforced Thermosetting Resin Conduit

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of raceway, boxes, or other potential obstructions within the dedicated equipment spaces and working clearances for equipment installed by other trades in accordance with the codes and manufacturer requirements.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate routing of power, low-voltage, and control conduits requiring fire-resistive protective assembly or electrical circuit protective system. Fire-resistive protective assembly or electrical circuit protective system for power, low-voltage, and control circuit conductors and cables shall have a fire-resistance rating of not less than 2 hours and shall be provided where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:

a. Feeders for Emergency Power systems where in areas not protected by an automatic fire suppression system.
b. Smokeproof Enclosure Pressurization systems
c. Smoke Control systems
d. Smoke Removal systems
e. Fire service and Occupant Evacuation Elevator systems

1.04 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".

B. Product data for the following products:
1. Floor boxes

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members in path of conduit groups with supports.
2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.

D. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
1. Accurately record actual routing of all exterior buried raceway and all interior raceways three inches and larger. Indicate dimensions from fixed structural elements.

1.05 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
2. Marked for intended use.

C. Comply with NFPA 70.

PART 2 PRODUCTS AND MATERIALS

2.01 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

A. Metal Conduit and Tubing
1. Available Manufacturers:
a. ABB, Inc.
b. Atkore
c. American Conduit
d. Anamet Electrical, Inc.
e. Electri-Flex Co.
f. Hubbell (Fittings).

g. Nucor Tubular Products.
h. O-Z/Gedney Co.; Emerson.
i. Southwire Company, LLC
j. Western Tube and Conduit Corporation.
k. Wheatland Tube Co.

2. RMC:
   a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.
      1) Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.04 inches (1mm), minimum.
   b. RAC: ANSI C80.5, UL6A.
3. IMC: ANSI C80.6, UL 1242.
   a. Plastic-Coated IMC and Fittings: NEMA RN 1, UL-listed.
4. EMT and Fittings: ANSI C80.3, UL 797. Only steel products allowed. Reduced wall EMT is not allowed.
   a. Fittings: Set-screw type.
5. FMC: Aluminum Zinc-coated steel: UL 1. Reduced wall FMC is not allowed.
6. LFMC: Flexible steel raceway with PVC jacket: UL 360.
   a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway
1. Available Manufacturers:
   a. ABB, Inc.
   b. American Pipe and Plastics, Inc.
   c. Anamet Electrical, Inc.
   d. Atkore
   e. Cantex Inc.
   f. Carlon
   g. Champion Fiberglass, Inc.
   h. Electri-Flex Co.
   i. Hubbell Inc. (Fittings)
   j. IPEX USA, LLC.
   k. Prime Conduit.
   l. Southwire Corporation.
   m. Superflex Ltd.
   n. United Fiberglass of America, Inc.
2. RNC: Schedule 80 PVC: NEMA TC 2, UL 651.
   a. Fittings: match to raceway and tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. Metal Wireways
1. Available Manufacturers:
   a. BEL Products, Inc.
   b. Cooper B-Line; Eaton.
   c. EPI-Electrical Enclosures
   d. Hoffman.
   e. Square D.
2. Material and Construction: 14-gauge (minimum) sheet steel, sized and shaped as indicated, NEMA 1.

3. Fittings and Accessories: Include couplings, offsets, elbows, expansion/deflection joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70. Where indicated, provide a barrier to divide wireway into compartments.
4. Wireway Covers:
   a. Hinged type
5. Finish: Manufacturer's standard phosphate pre-treatment and baked enamel finish.

D. Surface Metal Raceways
1. Available Manufacturers:
   a. ABB, Inc.
   b. Hubbell, Inc.
   c. Legrand.
   d. Mono-Systems; Niedax Group
   e. Panduit Inc.
2. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.02 BOXES, ENCLOSURES AND CABINETS

A. General
1. Available Manufacturers:
   a. ABB, Inc.
   b. American Midwest Power
   c. Appleton/O-Z Gedney Co.; Emerson.
   d. BEL Products, Inc.
   e. Cooper Crouse-Hinds; Eaton.
   f. Erickson Electrical Equipment Co.
   g. FSR, Inc.
   h. Hoffman.
   i. Hubbell, Inc.
   j. Legrand.
   k. Molex; Koch Industries.
   l. Robroy Industries, Inc.; Enclosure Division.
   m. Spring City Electrical Manufacturing Co.
2. Provide products listed, classified, and labeled as suitable for the purpose intended. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
3. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   2. Cast Metal Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover. Furnish with threaded hubs.
      a. List and label as complying with UL 514A for non-hazardous locations.
      b. List and label as complying with UL 886 for hazardous locations, where required.
   3. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   4. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   5. Boxes for Ganged Devices: Use multi-gang boxes of single-piece construction. Do not use field-connected gangable boxes.
   6. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices (Other Than Communications Systems Outlets): 4-inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
      b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Wall Plates: Comply with Division 26 Section “Wiring Devices”.

C. Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, and list and label as complying with UL 514A.
   2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast iron or aluminum with gasketed cover.
   3. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   4. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.

D. Floor Boxes
   1. General:
      a. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the tables below. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Manufacturers listed above and models that meet the specified criteria.
      b. Floor boxes used for power: Include a minimum of one normal 20A, 125V NEMA 5-20R duplex receptacle unless noted or scheduled otherwise on the Drawings. Wiring device color: Refer to Division 26 Section “Wiring Devices”, or as indicated on the Drawings.
      c. Floor boxes utilized for telephone, data, or both: Include provisions for mounting telephone/data outlets in accordance with the requirements of the telephone/data systems provider.
      d. UL514A listed for scrub water exclusion for all floor types.
   2. Box Type A: For slab on grade: round-faced, watertight, Class 1, fully adjustable cast iron box. For slab above grade: round-faced, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover

plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

Mfr	Cast Iron Box	Stamped Steel Box	Cover Plate (Power)	Cover Plate (Tel/Data)
Steel City	602	68D	P60-DS	P60-3/4-2
Walker	887	886	895T	896TCK
Hubbell	B2536	B2527	S3925	S2525

3. Box Type B: For slab on grade: single-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box. For slab above grade: single-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

Mfr	Cast Iron Box	Stamped Steel Box	Cover Plate (Power)	Cover Plate (Tel/Data)
Steel City	641	N/A	P64-DS	P64-3/4-2
Walker	880CS1	880S1	828R	829CK-3/4
Hubbell	B2436	B2431	S3825	S2425

4. Box Type C: For slab on grade: two-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: two-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

Mfr	Cast Iron Box	Stamped Steel Box	Cover Plate (Power)	Cover Plate (Tel/Data)
Steel City	642	N/A	P64-DS	P64-3/4-2
Walker	880CS2	880S2	828R	829CK-3/4
Hubbell	B4233	B2432	S3825	S2425

5. Box Type D: For slab on grade: three-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: three-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

Mfr	Cast Iron Box	Stamped Steel Box	Cover Plate (Power)	Cover Plate (Tel/Data)
Steel City	643	N/A	P64-DS	P64-3/4-2
Walker	880CS3	880S3	828R	829CK-3/4
Hubbell	B4333	B2433	S3825	S2425

6. For Multi-service Floor Boxes, see Division 26 Section “Common Work Results for Communications”.

E. Fire-Rated Poke-Through Outlets – TYPE A Single Service
1. UL listed and UL Fire Classified, flush type, with one- to four-hour fire rating, as required by floor rating and type.
2. Flush type:
   a. Single-service type: Capable of supporting, at a minimum, a duplex 20A/125V receptacle (or equivalent).
   b. Furniture-feed type: Single-service type as indicated on the Drawings.
   c. Cover plate, with individual device covers, and concrete floor flange, UL514A listed for scrub water exclusion.
   d. Color: as directed by the Architect.
3. For additional poke-through types, see Division 26 Section “Common Work Results for Communications”.

2.03 FACTORY FINISHES

A. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard paint, applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

PART 3 EXECUTION

3.01 INSTALLATION

A. General
1. Install in accordance with manufacturer’s instructions.

3.02 RACEWAYS

A. General
1. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this article are stricter.
2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 3/4 inch (concealed and exposed); 1 inch (underground and under slab).
3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.

4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
5. Install grounding bushings or other code compliant connections on all conduit terminations and bond to the enclosure, equipment grounding conductor, and electrical system ground.
6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Contract Administrator, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
8. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
9. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
10. Install raceways:
    a. To meet the requirements of the structure and the requirements of all other Work on the Project.
    b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
    c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Contract Administrator.
    d. Parallel or perpendicular to building lines or column lines.
    e. Tight to structure.
    f. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
11. Raceways Embedded in Slabs:
    a. Raceways may only be embedded in concrete slabs with written permission from, and only where directed, by the Structural Engineer.
    b. Install in middle 1/3 of slab thickness, where practical. At a minimum, concrete shall provide at least 2 inches of concrete cover for raceways.
    c. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
    d. Space raceways laterally to prevent voids in concrete.
    e. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
    f. Change from RNC to coated GRS or IMC before rising above the floor.
12. Where masonry, brick, CMU or concrete walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed, and the wall will have a neat and smooth appearance.
13. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section “Hangers and Supports for Electrical Systems”. Do not support raceways by hangers used for any other systems foreign to the electrical systems; and do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.
    a. Raceways on roof shall be supported from structure not from the roof deck.
14. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:
    a. Attach single raceway directly to structural steel with beam clamps.

b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
c. Attach groups of raceways to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
d. Attach groups of raceways to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.
f. Hang horizontally suspended groups of raceways using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
i. Use prefabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.

15. Install electrically and physically continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.
16. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Contract Administrator's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
17. Align and install raceway terminations true and plumb.
18. Complete raceway installation before starting conductor installation.
19. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
20. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints; or where structures providing a means of support are subject to relative movement greater than acceptable by the raceway manufacturer.
21. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Contract Administrator, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Contract Administrator, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.
22. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.

b. Where otherwise required by NFPA 70.

23. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment as required by other requirements of the construction documents.; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
24. Maintain 2” minimum spacing from bottom of roof deck to prevent raceway penetrations from above.
25. Do not route conduits across skylights, access panels, hatched tiles, HVAC diffusers, or equipment working space.
26. Route conduits serving rooftop equipment concealed inside the equipment curb and minimize roof penetrations and exterior conduit runs where practicable.
27. Install all underground conduits/raceways, outside the building footprint, a minimum of 24” below the bottom of paving/grade, unless noted otherwise, where practicable.
28. Install all underground conduits/raceways underneath building footprint slab-on-grade a minimum of 12” below bottom of slab, unless noted otherwise, where practicable.
29. Where conduits are subject to earth movement by settlement or frost, provide expansion fittings to prevent damage to enclosed conductors or connected equipment.
30. Provide boxes and raceways for the fire protection system low voltage wiring as required. This includes low voltage wiring exposed less than 96” AFF.
    a. At a minimum, provide 3/4” conduit.
    b. Coordinate requirements and locations with system installer and fire alarm specifications.

B. RMC
1. Use GRS or IMC in the following areas:
    a. Where indicated.
    b. Exterior applications where above grade and exposed.
    c. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
2. Use RAC in the following areas:
    a. Indoors above grade.
    b. Interior wet or damp locations.
    c. For circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
3. Do not use RAC:
    a. Below grade.
    b. Imbedded in concrete or other areas corrosive to RAC.

C. EMT
1. Use EMT in the following areas:
    a. Where indicated.
    b. Interior concealed locations for:
        1) Branch circuits.
        2) Low-voltage control, security, and fire alarm circuits
2. Do not use EMT:
    a. Below grade.
    b. In exterior applications when exposed.

D. FMC and LFMC
   1. Use FMC or LFMC:
      a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
      b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.
   2. Do not use FMC or LFMC:
      a. For branch circuits, homeruns or feeders.
      b. In lengths exceeding 6 feet.

E. RNC
   1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.
   2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per NFPA 70, to accommodate thermal expansion in straight runs.
   3. RNC is only allowed to be used in the following locations:
      a. Where specifically indicated, and then only as specified below.
      b. Underground, single and grouped, in lieu of GRS or IMC, when indicated.
         1) Concrete-encased (use approved rigid PVC interlocking spacers, selected to provide minimum duct spacing and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts).

F. Telephone and Signal/Data System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

3.03 RACEWAY FITTINGS:

A. Compatible with raceways and suitable for use and location.

B. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.

C. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.

D. Join raceways with fittings designed and approved for that purpose and make joints tight.

E. Use insulating bushings to protect conductors at raceway terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

3.04 WIREWAYS:

A. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.

B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

C. Close ends of wireway and unused raceway openings.

3.05 BOXES:

A. General
1. Verify locations of device boxes prior to rough in.
2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
6. Support boxes independently of raceway.
7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.

B. NEMA Enclosure ratings, Suitable for the environment in which it is installed. At a minimum, provide the following ratings:
1. NEMA 250, type 3R
   a. Provide at exterior locations
2. NEMA 250, type 1
   a. Provide at interior and dry locations
3. NEMA 250 type 4 stainless steel
   a. Provide at interior damp or wet locations
   b. Provide at interior locations where associated device is labeled as Weather Proof and/or Weather Resistant, unless requirement below already requires box to be rated otherwise.
4. NEMA 250 type 4X
   a. Provide at interior locations subject to corrosion

C. Outlet Boxes
1. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Contract Administrator. Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.

2. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
3. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes Use sheet-steel boxes for dry locations unless otherwise indicated or required.
4. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
5. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
6. Use cast aluminum boxes where aluminum rigid metal conduit is used.
7. Use nonmetallic boxes where exposed rigid PVC conduit is used.
8. Use suitable concrete type boxes where flush-mounted in concrete.
9. Use suitable masonry type boxes where flush-mounted in masonry walls.
10. Use raised covers suitable for the type of wall construction and device configuration where required.
11. Use shallow boxes where required by the type of wall construction.
12. Install extension and plaster rings as required by NFPA 70.
13. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
14. Do not exceed allowable fill per NFPA 70.
15. Where multiple devices are shown grouped together, gang mount with a common cover plate.

D. Junction and Pull Boxes
1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
2. Provide boxes set flush in painted walls or ceilings with primer coated cover.
3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.
4. Boxes for exterior use shall be:
    a. PVC with a UV-stabilized PVC cover sealed and gasketed watertight.
    b. Cast aluminum with a cast aluminum cover sealed and gasketed watertight.
    c. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
    d. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.

E. Floor Boxes
1. Use cast or non-metallic floor boxes for installations in slab on grade. Unless otherwise indicated, formed steel boxes are acceptable for slabs above grade.
2. Set metal floor boxes level and flush with finished floor surface.
3. Set non-metallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.06 IDENTIFICATION

A. Refer to Division 26 Section “Identification for Electrical Systems” for identification materials.

END OF SECTION 260533

SECTION 260548
SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This section includes general seismic requirements specific other sections of the Division 26 specifications.

1.02 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.03 SUMMARY

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEPFTR Systems”.

B. The following equipment shall withstand the effects of earthquake motions. The equipment will remain in place without separation of any parts from the device when subjected to the seismic forces specified:
   1. Panelboards used in normal power systems
   2. Raceways and Boxes used in normal power systems
   3. Low-Voltage Transformers used in normal power systems
   4. Switchboards used in normal power systems
   5. Panelboards used in normal power systems

1.04 SUBMITTALS

A. Provide submittals as required by Division 20 Section “Seismic Controls for MEPFTR Systems” for all electrical systems specified herein.

PART 2 PRODUCTS AND MATERIALS
(Not Used)

PART 3 EXECUTION
(Not used)

END OF SECTION 260548

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes the following:
1. Nameplates.
2. Labels for raceways and metal-clad cable.
3. Labels for junction boxes and pull boxes.
4. Labels for wiring devices and lighting control devices.
5. Markers for conductors, and control cables.
6. Tags.
7. Underground-line warning tape.
8. Warning labels and signs.
9. Arc Flash Warning Labels.
10. Instruction signs.
11. Miscellaneous identification products.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.

B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

C. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

D. Coordinate installation of identifying devices with location of access panels and doors.

E. Install identifying devices before installing acoustical ceilings and similar concealment.

1.03 QUALITY ASSURANCE

A. Electrical Equipment, Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
2. Marked for intended use.

B. Comply with ANSI A13.1 and ANSI C2.

C. Comply with requirements of NFPA 70.

D. Comply with 29 CFR 1910.145.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Location, text, and method of identification to be used is noted in individual sections. Refer to other sections for additional identification requirements.

2.02 NAMEPLATES

A. Comply with UL RP 9691, Recommended Practice for Nameplates for Use in Electrical Installations.

B. Engraved, Laminated Acrylic or Melamine Label: Non-conductive phenolic with beveled edges.
1. Adhesive backed.
2. Minimum 1/16 inch (1.6 mm) thick for nameplates with both dimension 4 inches (102 mm) or less and 1/8 inch (3.2 mm) thick for larger sizes.

C. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

D. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text

E. Text: Minimum text height shall be 1/8 inch (3.2 mm) unless otherwise required by local jurisdiction or owner standards. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.

F. Colors:
1. Normal systems - white letters on a black background.
2. Emergency systems - white letters on a red background.

G. Label Requirements:
1. Service Equipment Label

LINE 1: NOMINAL VOLTAGE AND FREQUENCY IN HERTZ
LINE 2: SERVICE EQUIPMENT BUS RATING IN AMPS
LINE 3: SCCR OF SERVICE EQUIPMENT IN AMPS
LINE 4: MAXIMUM AVAILABLE FAULT CURRENT IN AMPS
LINE 5: DATE CALCULATED

EXAMPLE:

208Y/120V, 60HZ 800A SCCR = 65,000A MAX AVAILABLE FAULT CURRENT = 58,815A CALCULATED: 01/01/2018

2. Panelboard/Switchboard Label:

LINE 1: PANELBOARD/SWITCHBOARD DESIGNATION
LINE 2: VOLTAGE, PHASE, WIRES, AMPS
LINE 3: FED FROM “ “

EXAMPLES:

H1A 480Y/277V, 3PH, 4W, 200A FED FROM MDB

L1A 208Y/120V, 3PH, 4W, 225A FED FROM H1A VIA XFMR T1

3. Transformer Label:
   LINE 1: TRANSFORMER DESIGNATION
   LINE 2: FED FROM " "
   LINE 3: SUPPLIES " "

   EXAMPLE:

T1 FED FROM H1A SUPPLIES L1A

4. Disconnect Switch Label:
   LINE 1: DESIGNATION OF EQUIPMENT SERVED BY DISCONNECT
   LINE 2: VOLTAGE, PHASE, WIRES, AMPS
   LINE 3: FED FROM " "

   EXAMPLES:

WATER HEATER WH1 480V, 3PH, 3W, 100A FED FROM MDB

2.03 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

A. Factory Painted Raceways:
   1. Metal Raceways: Continuous, rust-inhibiting paint factory applied.
   2. Non-Metallic Raceways: Factory dyed or colored PVC sleeve.

B. Factory Painted Metal-Clad Cable: 2-inch wide, factory painted bands at a maximum of 6-foot on center spacing.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.04 LABELS FOR JUNCTION BOXES AND PULL BOXES

A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

2.05 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

A. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

B. Engraved, Laminated Acrylic or Melamine Label: adhesive backed. Minimum letter height shall be 3/16 inch (4.76 mm).
   1. Normal systems - white letters on a black background.
   2. Emergency systems - white letters on a red background

C. Engraved cover plates: Provide with white letters. White or ivory cover plates shall have black letters.

D. Permanent Ink: Permanent, waterproof, black ink marker, hand printed legibly.

2.06 MARKERS FOR CONDUCTOR AND CONTROL CABLES

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

D. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

E. 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 nylon tie fastener.

2.07 TAGS

A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.08 UNDERGROUND-LINE WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color: Tape for Buried Power Lines: Black text on red background.

2.09 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.

B. Self-Adhesive Warning Labels: Factory pre-printed or machine-printed multicolor self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
1. Use thermal transfer process printing machines and accessories recommended by label manufacturer.
2. Do not use labels designed to be completed using handwritten text.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

2.10 ARC FLASH WARNING LABELS

A. General: All labels will be based on recommended overcurrent device settings and will be printed after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system. Refer to Division 26 section “Power System Studies” for additional requirements.

B. Materials: Use machine-printed, high adhesion, polyester label; UV, chemical, water, heat, and abrasion resistant, for each work location analyzed.

C. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer. Labels shall be machine printed, with no field markings. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.

D. Minimum Size: 3.5 inch by 5 inch (89 mm by 127 mm), unless otherwise noted by Owner.

E. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment. The label shall include the following information, at a minimum:
1. Location designation
2. Nominal voltage
3. Available fault current
4. Limited approach boundary
5. Arc flash boundary
6. Restricted approach boundary
7. Hazard risk category
8. Incident energy
9. Working distance
10. Site-specific PPE (personnel protective equipment) requirements.
11. Date calculations were performed.
12. Engineering report number, revision number and issue date.

2.11 INSTRUCTION SIGNS

A. Engraved, Laminated Acrylic or Melamine plastic: Non-conductive phenolic. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.
1. Minimum 1/16 inch (1.6 mm) thick for nameplates with either dimension greater than 4 inches (102 mm) and 1/8 inch (3.2 mm) thick for larger sizes.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
4. Normal systems: Engraved legend with white letters on black face.
5. Essential Systems: Engraved legend with white letters on red face.

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.6 kg), minimum.
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.

B. Fasteners for Nameplates, Labels and Signs
1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.

2.13 PAINTED IDENTIFICATION

A. Paint materials and application requirements are specified in Division 09 painting Sections.

1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Exterior concrete and masonry primer.
      2) Finish Coats: Exterior semi-gloss acrylic enamel.
2. Exterior Concrete Unit Masonry:
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      1) Block Filler: Concrete unit masonry block filler.
      2) Finish Coats: Exterior semi-gloss acrylic enamel.
3. Exterior Ferrous Metal:
   a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Exterior ferrous-metal primer.
      2) Finish Coats: Exterior semi-gloss alkyd enamel.
4. Exterior Zinc-Coated Metal (Except Raceways):
   a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Exterior zinc-coated metal primer.
      2) Finish Coats: Exterior semi-gloss alkyd enamel.
5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
   a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior concrete and masonry primer.
      2) Finish Coats: Interior semi-gloss alkyd enamel.
6. Interior Concrete Unit Masonry:
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      1) Block Filler: Concrete unit masonry block filler.
      2) Finish Coats: Interior semi-gloss acrylic enamel.
7. Interior Gypsum Board:
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior gypsum board primer.
      2) Finish Coats: Interior semi-gloss acrylic enamel.
8. Interior Ferrous Metal:
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior ferrous-metal primer.
      2) Finish Coats: Interior semi-gloss acrylic enamel.
9. Interior Zinc-Coated Metal (Except Raceways):
   a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior zinc-coated metal primer.
      2) Finish Coats: Interior semi-gloss acrylic enamel.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify identity of each item before installing identification products.

B. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

C. Provide identification product listed for the location in which it is to be installed.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. For surfaces that require finish work, apply identification devices after completing finish work. Do not install identification products until final surface finishes and painting are complete.

C. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed. Replace labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

D. Location: Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance without interference with operation and maintenance of equipment. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.

G. Install identification products centered, level, and parallel with lines of item being identified.

H. Mark all handwritten text, where permitted, to be neat and legible.

I. For refrigeration systems: Neatly bundle circuits and clearly tag and label each circuit with panelboard, branch circuit designation and refrigeration system number at each termination.

END OF SECTION 260553

SECTION 260573
POWER SYSTEM STUDIES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes computer-based studies for the following:
   1. Short-circuit analysis.
   2. Protective device coordination study.
   3. Arc flash and shock risk assessment, including arc flash hazard labels.
   4. Harmonic study.

B. Criteria for selection and adjustment of equipment and associated protective devices not specified in this section, as determined by the studies performed.

1.02 ADMINISTRATIVE REQUIREMENTS

A. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the short-circuit study. Device ratings for furnished equipment shall be as required by the results of the short-circuit study at no additional cost.

B. Coordination:
   1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
   2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   3. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

C. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.

D. Sequencing:
   1. Initial Study:
      a. Study must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. Do not order equipment until matching study reports and product submittals have both been evaluated by the Contract Administrator.
      b. If study has not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the Contractor at no additional cost to the project.
   2. Final Study:
      a. Study must be completed and submitted for review prior to substantial completion. Do not print arc flash labels until final study has been evaluated by the Contract Administrator.
      b. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels.

E. Scheduling:
   1. Arrange access to existing facility for data collection with Owner.
   2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner. Refer to Division 26 section "General Electrical Requirements" for additional requirements.

1.03 SUBMITTALS

A. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Product data for computer software program to be used for studies.
   2. Include characteristic time-current trip curves for protective devices.
   3. Include impedance data for busway.
   4. Include impedance data for engine generators.
   5. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   6. Include documentation of listed series ratings upon request.
   7. Identify modifications made in accordance with studies to meet the results of the study.

B. Electronic files, in an SKM-compatible format, of the time-current characteristic curves for every different overcurrent device used in the reports.

C. Product Certificates: For coordination-study and short-circuit-study computer software programs, certifying compliance with IEEE 399.

D. Qualification Data:
   1. Study Preparer Specialist qualifications.
   2. Field Testing Agency qualifications.

E. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

F. Other Action Submittals:
   1. Initial Study report, stamped or sealed and signed by study preparer, including:
      a. Cover page including date of study, study methodology, assumptions made and software products used.
      b. Study input data, including completed computer program input data sheets.
      c. Short-circuit study report.
      d. Equipment evaluation report.
      e. Coordination-study report.
      f. Settings report.
      g. Harmonic analysis report.
   2. Final Study report, stamped or sealed and signed by study preparer, including:
      a. Cover page including date of study, study methodology, assumptions made, software products used, and summary of changes between initial and final studies.
      b. Study input data, including completed computer program input data sheets.
      c. Short circuit study report.
      d. Equipment evaluation report.
      e. Coordination-study report.
      f. Settings report.

g. Harmonic analysis report.
h. Arc-Flash Hazard Analysis, including labels.

3. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

G. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":

1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.
2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.
3. Include copies of previous studies and existing drawings that were obtained during the data collection phase of the study.

1.04 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Study Preparer Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Comply with IEEE 399 for general study procedures.

D. Comply with IEEE 241, 242 and 551 for short-circuit currents and coordination time intervals.

E. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard calculations.

PART 2 PRODUCTS AND MATERIALS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, use the latest commercially available computer software programs utilizing the specified methodologies developed by one of the following:

1. SKM Systems Analysis, Inc: *www.skm.com*.

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of short-circuit-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
   1. Zero-Sequence current.
   2. Arcing faults.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

C. Short-circuit study and coordination study to be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that correct equipment gets ordered for the project conditions.

D. Arc Flash Study must be performed after conductors and equipment have been installed and after the project's utility company confirms the available fault current. A final short-circuit and coordination study with all device settings shall be submitted with the Arc Flash Study. The goal of the revised settings is to minimize the arc flash hazard while maintaining reasonable coordination and selectivity. For the components of emergency and legally required standby system components, full selectivity must be maintained.

3.02 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

A. Study shall begin with the utility and each alternate power source overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device. This includes studies of the complete paths and operating modes on both sides of any transfer switch, contactor or circuit breaker.

B. Components include, but are not limited to:
   1. Switchgear
   2. Switchboards
   3. Distribution Panelboards
   4. Panelboards
   5. Roof Top HVAC equipment

3.03 POWER SYSTEM DATA FOR STUDIES

A. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling. Gather and tabulate the following input data to support studies:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:
    a. Indicate load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
    b. Protective Devices: Include circuit-breaker and fuse-current ratings and types;
    c. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
    d. Generators: Include manufacturer/model, kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor insulation, and length.
    f. Busways: Include bus material, ampacity and impedance.
    g. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
    h. Variable frequency drive rating, manufacturer, and model series.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Magnetic inrush current overload capabilities of transformers.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Ratings, types, and settings of utility company's overcurrent protective devices.
    e. Special overcurrent protective device settings or types stipulated by utility company.
    f. Protective Devices:
        1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
        2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.

3.04 SHORT-CIRCUIT STUDY

A. Source Impedance: As an infinite bus on primary side of utility transformer.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operation modes that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
   1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
   2. Low-Voltage Fuses: IEEE C37.46.
   3. Circuit Breakers: IEEE C37.13.

F. Study Report:
   1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
   2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- and high-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
   3. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault current values for 3-phase, 2-phase, and phase-to-ground faults.

G. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing short-circuit current ratings of these devices with calculated short-circuit current momentary and interrupting duties. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

3.05 COORDINATION STUDY

A. Perform coordination study and prepare a written report using the results of the short-circuit study and approved computer software program. Comply with IEEE 399.

B. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

C. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

D. Analyze alternate scenarios considering known operating modes.

E. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

F. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase

conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

G. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
      a. Device tag.
      b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
      c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
      d. Fuse-current rating and type.
      e. Ground-fault relay-pickup and time-delay settings.
   2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve the level of selective coordination required in the contract documents or by the edition of the National Electrical Code (including any local jurisdiction amendments) the project must comply with. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:
      a. For protective Devices:
         1) Device tags.
         2) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
         3) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
         4) Include ground fault pickup and delay.
         5) Include fuse ratings.
      b. Voltage and current ratio for curves.
      c. Three-phase and single-phase damage points for each transformer.
      d. No damage, melting, and clearing curves for fuses.
      e. Cable damage curves.
      f. Generator full load current, overload curves, decrement curves and short-circuit withstand points.
      g. Transformer inrush points.
      h. Maximum fault current cutoff point.
      i. Capacitor full load current and damage curves.
   3. Include conclusions and recommendations.
   4. Completed data sheets for setting of overcurrent protective devices.
   5. For emergency, legally required standby and health care essential power systems, such systems must selectively coordinate to the values indicated below unless local amendments to the National Electrical Code require a different value.
      a. Emergency (NEC article 700) 0.01 seconds
      b. Legally Required Standby (NEC article 701) 0.01 seconds
      c. Elevator Systems (NEC article 620) 0.01 seconds

3.06 ARC-FLASH HAZARD ANALYSIS

A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies in accordance with IEEE 1584. Perform the analysis under worst-case arc-flash conditions for all modes of operation.

B. In addition to the requirements outlined in IEEE 1584, the study shall include all equipment rated less than 240 Volts fed by transformers less than 125 kVA in the calculations.
   1. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
   2. For single-phase systems, the calculations may be performed assuming a three-phase system in accordance with IEEE 1584, yielding conservative results.

C. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.

D. Identify all locations and equipment to be included in the arc-flash hazard analysis:
   1. Include a copy of the facility one-line in the report.
   2. Identify the possible system operating modes including tie-breaker positions, and parallel generation.
   3. Calculate the arcing fault current flowing through each branch for each fault location.
   4. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
   5. Select the working distances based on system voltage and equipment class.
   6. Calculate the incident energy at each fault location at the prescribed working distance.
   7. Determine the hazard/risk category (HRC) for the estimated incident energy.
   8. Calculate the flash protection boundary at each fault location.
   9. Document the assessment in reports and one-line diagrams.
   10. Provide labels to be placed on each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.

E. Results of the arc-flash study shall be summarized in a final report containing the following:
   1. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
   2. Tabulations of the data used to model the system components and a corresponding one-line diagram.
   3. Descriptions of the modes of operation evaluated and identification of the worst case scenario used to evaluate equipment ratings.
   4. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
   5. Required arc-flash labeling and placement of labels.
   6. Conclusions and recommendations, including recommendations for reducing incident energy at locations where calculated maximum incident energy exceeds 8 calories per sq cm.

3.07 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, [to set] [to assist in setting of] overcurrent protective devices within equipment.
   1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
      a. Verify that overcurrent protective devices meet parameters used in studies.
      b. Adjust devices to values listed in final study results.

c. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 100.7 and 100.8 in NETA ATS.

3.08 INSTALLATION

A. Install arc flash warning labels. Refer to Division 26 section Identification for Electrical Systems for additional requirements.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Inspect and test protective devices in accordance with the NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Overcurrent protection devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies protective device settings have been adjusted in accordance with the requirements of the study. Include notation of conflicts with or deviations made from the studies or the contract documents, deficiencies detected, remedial action taken, and observations after remedial action.

3.10 TRAINING

A. Provide training for Owner’s personnel on electrical safety pertaining to arc flash and shock hazards.

B. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.

C. Provide minimum of eight hours of training performed by a representative of the entity performing the study.

END OF SECTION 260573

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SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This Section includes the following lighting control devices:
   1. Stand-Alone Low-voltage occupancy sensors.
   2. Stand-Alone Low-voltage power packs.
   3. Stand-Alone Low-voltage switches.
   4. Time switches.
   5. Lighting contactors.
   6. Conductors and Cables for Lighting Control Devices.

1.02 DEFINITIONS

A. Acoustic Type: Occupancy sensor detection type that detects occupancy by listening for acoustic noises.

B. Closed loop: Photosensor control algorithm designed for influence by both daylight and electric light in a space or area.

C. DPDT: Double pole, double throw.

D. DPST: Double pole, single throw.

E. Dual-Technology Type: Occupancy sensor detection type that detects occupancy by using a combination of PIR and ultrasonic or acoustic detection technologies.

F. LED: Light-emitting diode.

G. Open loop: Photosensor control algorithm designed for influence by daylight entering in a space or area.

H. PIR Type: Passive infrared. Occupancy sensor detection type that detects occupancy by sensing a combination of infrared heat and movement.

I. SPST: Single pole, single throw.

J. Ultrasonic Type: Occupancy sensor detection type that detects occupancy by sensing a change in pattern of reflected ultrasonic energy.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.04 SUBMITTALS

A. Product data for the following products:
   1. Catalog cut sheets, including major and minor motion coverage patterns sensors, time delay and sensitivity adjustability settings, load restrictions, and performance specification items indicating compliance with this specification for all lighting control devices.
   2. Documentation showing compliance with California Energy Commission certification.

B. Shop Drawings:
   1. Occupancy sensors and photoelectric switches
      a. Show installation details.
      b. Lighting plan showing location, mounting height, orientation and coverage area of each sensor and coordination with other trades.
      c. Interconnection diagrams showing field-installed wiring.
      d. Include diagrams for power, signal, and control wiring.
      e. For any manufacturer submitted other than that listed as the Basis of Design, provide the following information for Engineer review:
         1) Factory-generated occupancy sensor and photoelectric switch layouts on project lighting plans with sensor location, orientation and product type clearly marked on plans. Sensor placement shall be coordinated with project reflected ceiling plan layout, ceiling heights, lights, diffusers, and any other ceiling devices and equipment.
         2) List of any deviations to this specification or Basis of Design products.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
   1. Occupancy sensors and photoelectric switches:
      a. Manufacturer's installation instructions, including instructions for storage, handling, protection, examination, preparation, start-up calibration and installation.
      b. Product data clearly showing sensor field adjustments, including dip switch setting definitions and location of settings within sensors.
      c. Manufacturer's maintenance, including operating and adjustment instructions.
   2. Timeclocks
      a. Description of programmed timeclock settings at time of substantial completion.
   3. Line-voltage wall box dimming switches
      a. Provide operating instructions for each type of dimmer.

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. Occupancy sensors and photoelectric switches
   1. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of 5 years.
   2. Products shall be manufactured by an ISO 9001 certified manufacturing facility.
   3. Manufacturer shall test all equipment prior to shipment.

1.06 WARRANTY

A. Manufacturers shall provide a five (5) year warranty for sensors and accessories from date of Substantial Completion.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL INFORMATION

A. PIR type requirements:
   1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
   2. Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
   3. Sensor shall provide high immunity to false triggering from RFI and EMI.
   4. Sensor shall have a multiple-segmented fresnel lens in a multiple-tier configuration, with grooves to eliminate dust and residue buildup. Sensor shall be capable of accepting mask inserts to mask specific portions of the lens to prevent false triggering.

B. Ultrasonic type requirements:
   1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   2. Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHZ within +/- 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk.
   3. Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within +/- 0.005% tolerance, to assure reliable performance and eliminate sensor cross-talk.
   4. Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.

C. Acoustic type requirements:
   1. Detector Sensitivity: Acoustic type technology shall only be used as secondary to PIR in a Dual-Technology Type sensor. Specific sensitivity is based on PIR technology.
   2. Sensors shall distinguish noises made by human activity (typing, talking, eating, etc.) and filter out noises made by the environment or building (HVAC, equipment, cars, etc.).
   3. Acoustic technology shall enhance reliability and accuracy of PIR sensor.

D. Dual-Technology type requirements:
   1. Dual-Technology sensors using ultrasonic technology shall have field-selectable controls on unit to determine if a particular technology or combination of technologies controls the on-off function.
   2. Dual-Technology sensors using acoustic technology shall have the PIR technology initially detect motion and a combination of PIR and acoustic technologies shall keep the load on.
   3. Sensitivity Adjustment: Separate for each sensing technology.
   4. Different LED indicator colors for each sensing technology
   5. PIR sensor component shall comply with all requirements listed under PIR type requirements.
   6. Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type requirements.

7. Acoustic sensor component shall comply with all requirements listed under Acoustic Type requirements.

2.02 STAND-ALONE LOW-VOLTAGE OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensor unit, for use with a separate stand-alone low-voltage power pack containing a line-voltage relay.
   1. Occupancy sensors and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
   2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. UL Listed for dry locations and complies with local codes.
   4. Complies with California's Title 24 and is certified by the California Energy Commission.
   5. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.
      a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
      b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of a separate, associated switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
   6. Switch Rating: As indicated in Lighting Control Device Schedule.
   7. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
   8. Mounting: Suitable for mounting in any position on a standard outlet box.
   9. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   10. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
   11. Bypass Switch: Override the "on" function in case of sensor failure, concealed on unit to prevent tampering.
   12. Finish: Sensor finish shall be white or off-white.
   13. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.
   14. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
   15. Sensors:
      a. Sensor shall be compatible with lighting control system.
      b. Sensors shall be capable of being combined with additional sensors to achieve adequate coverage.
      c. Sensor coverage pattern: AS indicated on Lighting Control Device Schedule, and shall have been confirmed with NEMA WD7 Guide and Robotic test method.
      d. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.

C. High-Bay Model:
   1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.

D. Extreme Temperature Model:
   1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
   2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.03 STAND-ALONE LOW-VOLTAGE POWER PACKS

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for power packs: Box mounted, solid-state indoor power pack/relay unit, for use with a separate stand-alone low-voltage sensor and switches.
   1. Power packs and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
   2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. UL Listed for dry locations and complies with local codes.
   4. Complies with California's Title 24 and is certified by the California Energy Commission.
   5. Unit shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
   6. Relay shall be compatible with the specific lighting types controlled.
   7. Operations: Refer to drawings for Sequence of Operations or other operational instructions. Unit operates in conjunction with other system components. Refer to operations requirements of associated devices.
   8. Switch Rating: As indicated in Lighting Control Device Schedule.
   9. Mounting: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   10. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.04 STAND-ALONE LOW-VOLTAGE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

B. General Requirements for switches: Wall-mounted, solid-state indoor manual switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
   1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
   2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. UL Listed for dry locations and complies with local codes.

4. Complies with California's Title 24 and is certified by the California Energy Commission.
5. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Manual push of any button shall energize or de-energize loads.
6. Mounting: Suitable for mounting in any position on a standard outlet box.
7. Indicator: LED, for each button to indicate when loads are energized and de-energized.
8. Finish: Sensor finish shall be white or off-white.
9. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.05 TIME SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Area Lighting Research, Inc.; Tyco Electronics.
   2. Intermatic, Inc.
   3. Leviton Mfg. Company Inc.
   4. Lithonia Lighting; Acuity Lighting Group, Inc.
   5. Paragon Electric Co.; Invensys Climate Controls.
   6. Square D; Schneider Electric.
   7. TORK; NSI Industries.
   8. Wattstopper; a Legrand Company.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
   1. Contact Rating: 20-A ballast load, 120/240-V ac.
   2. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

C. Time switches shall Comply with California's Title 24 and be certified by the California Energy Commission.

2.06 LIGHTING CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   2. Eaton Electrical Inc.; Cutler-Hammer Products.
   3. GE Industrial Systems; Total Lighting Control.
   4. Hubbell Lighting.
   5. Lithonia Lighting; Acuity Lighting Group, Inc.
   6. Square D; Schneider Electric.
   7. TORK; NSI Industries.

B. Description: Electrically operated and electrically held, combination type with non-fused disconnect, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including LED tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation. Refer to FCA value on drawings, at nearest upstream device.
3. Enclosure: Provide with enclosure complying with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

2.07 CONDUCTORS AND CABLES FOR LIGHTING CONTROL DEVICES

A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.

B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.

C. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG.

D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG.

E. Provide all necessary conductor and cabling required for operation of the controls and control systems specified. This includes power and control wiring required for the controls to operate as described.

PART 3 EXECUTION

3.01 INSTALLATION

A. GENERAL
1. Install devices and associated power packs and wiring in accordance with manufacturer’s instructions and applicable codes.

B. LINE VOLTAGE WALL SWITCHES
1. Install dimming wall switches to achieve full rating specified on Lighting Control Device Schedule taking into account de-rating for ganging as instructed by the manufacturer.
2. Provide a separate grounded (neutral) conductor for each circuit controlled by a line voltage switch.
   a. Do not share neutral conductor on load side of dimmers.
   b. If neutral termination is not required for the device, cap conductor and tag as “Neutral for future use”.

C. OCCUPANCY/VACANCY SENSORS AND PHOTOELECTRIC SWITCHES
1. Arrange a pre-installation meeting with manufacturer’s factory authorized field representative, at Owner’s facility, to verify placement of sensors and installation criteria.
2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage areas specified in manufacturer's literature. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate

only the rooms or areas that are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective areas.

3. 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.
4. Occupancy sensors with ultrasonic or dual-technology sensing technologies shall be located not closer than 4 feet from the nearest edge of air supply devices or similar obstructions that would adversely affect the sensor performance.
5. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
6. Install outdoor photoelectric switches with clear view of the northern sky unless noted otherwise on the Drawings.
7. Adjust settings of photoelectric switches to turn on lighting at illumination level indicated on the Drawings.
8. Install devices and auxiliary equipment in compliance with manufacturer's instructions and recommendations.
9. Install relay units where concealed from view and where accessible.
10. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
11. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

D. TIME SWITCHES
1. Install time switches in locations as indicated on the Drawings.
2. Program time switches with current time and date information in accordance with manufacturer's instructions.
3. Program timeclock settings as per Sequence of Operations on the Drawings. Confirm final timeclock settings with Owner prior to programming.

E. LIGHTING CONTACTORS
1. Install lighting contactors in locations as indicated on the Drawings.
2. Provide NEMA 1 enclosures for lighting contactors in interior dry locations, NEMA 3R enclosures for lighting contactors in exterior or wet locations.
3. 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.
4. Coordinate connection and programming of BAS Interface with controls contractor.

F. WIRING
1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be [1/2 inch (13 mm)][<insert size>].
2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.02 IDENTIFICATION

A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."

B. Power and control wiring: Identify using marker tapes.
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric switches and occupancy sensors at each sensor.

C. Components: Label each component with self-laminating computer printed labels, using a unique designation matching control drawing.

D. Cover plates: Refer to drawings for labeling requirements of certain cover plates for manual switches, or similar devices, requiring labeling for user information.

E. Buttons/switches:
   1. Engraved from manufacturer. Refer to drawings for detailed requirements and text for labeling.
   2. As indicated on drawings.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Test all occupancy sensors in test mode to confirm sensor coverage and sensitivity of sensor per manufacturer’s instructions. Upon completion of tests, set sensor time delay as indicated on Lighting Control Device Schedule. Follow testing and adjustment procedures as written in the manufacturer’s installation instructions for each sensor model.

B. Lighting control devices that fail tests and inspections are defective work. Remove, replace, and retest devices that fail tests.

3.04 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

B. Photoelectric switch Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project for this purpose.

END OF SECTION 260923

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SECTION 262413
SWITCHBOARDS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Service and distribution switchboards 600 V and less. (CD Controls)

B. Surge Protection Devices.

C. Disconnecting and overcurrent protective devices.

D. Control power.

E. Accessory components and features.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Equipment indicated herein are NATIONAL ACCOUNT items purchased by the Owner or General Contractor as determined by the Owner prior to bid call, and received, store, and installed by the General Contractor.

D. The pre-manufactured electrical products shall be purchased from the approved supplier:
   1. Custom Designed Controls (CD Controls), 55 Gateway Drive, Lavonia, GA 30553, Tel: (706) 356-3025, Fax: (706) 356-0329

1.03 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section “Overcurrent Protective Device Coordination Study”

D. Qualification Data: For qualified Installer.

E. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

G. CD Controls “Process and Procedure” manual for Contractors review and use.

H. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Handle and prepare switchboards for installation according to NECA 400.

C. Environmental Limitations:
1. Do not deliver or install switchboards until spaces are enclosed and weather tight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

D. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

E. Remove loose packing and flammable materials from inside switchboards.

1.06 FIELD CONDITIONS

A. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 2, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.07 WARRANTY

A. Warranty Period: Five years from date of Substantial Completion.

1.08 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 PRODUCTS AND MATERIALS

2.01 SERVICE AND DISTRIBUTION SWITCHBOARDS, 600 VOLTS AND LESS

A. The only acceptable manufacturer of the SES is General Electric Co. “Spectra Series”.

B. Front-Connected, Front-Accessible Switchboards:
   1. Main Devices: Fixed, individually mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

C. Nominal System Voltage: As indicated.

D. Main-Bus Continuous: As indicated.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Outdoor Enclosures: Type 3R.
   1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
   2. Enclosure:
      a. Roof: Downward, rearward sloping
      b. Rear covers: bolt-on, for each section, with provisions for padlocking.

H. Barriers: Between adjacent switchboard sections.

I. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

J. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

M. Buses: Three phase, four wire unless otherwise indicated.
   1. Phase, and Neutral Buses:
      a. Material:
         1) Tin-plated aluminum.
            a) Hard-drawn copper, 98 percent conductivity,may be substituted if provided at no additional cost.
         2) Hard-drawn copper, 98 percent conductivity.

b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus

2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
a. Material: Hard-drawn copper, 98 percent conductivity
b. Size: Minimum-size required by UL 891
3. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

N. Line-Side Conductor Connectors (Lugs):
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 section “Low-Voltage Electrical Power Conductors and Cables”.
2. Material: Same as bus material.
3. Capacity rating: Same as associated bus.
4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.

O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

P. Service Equipment Label: Where used as service entrance equipment, provide NRTL label for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

Q. Main switchboards used as service entrance equipment shall be provided with infrared windows in quantities and locations to provide line-of-sight viewing of all cable terminations on the line side of the main overcurrent protective device.

2.02 SURGE PROTECTION DEVICES

A. Provide surge protective devices as required by Division 26 Section “Surge Protective Devices”.

B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Arc Flash Mitigation
1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style as indicated, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    h. Under voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

C. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
    1. Fixed circuit-breaker mounting.
    2. Two-step, stored-energy closing.
    3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
        a. Instantaneous trip.
        b. Long- and short-time time adjustments.
        c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: as indicated, or as required by control devices per power supply.

D. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Boltswitch, Inc.
   b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   c. Pringle Electrical Manufacturing Company, Inc.
   d. Siemens Energy & Automation, Inc.
   e. Square D; a brand of Schneider Electric.
2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
   a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
   a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
   c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
   d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

F. Fuses are specified in Division 26 Section "Fuses."

2.04 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.05 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install switchboards and accessories according to NECA 400.

C. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to switchboards.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard with a nameplate.

C. Device Nameplates: Label each branch circuit device in distribution switchboard with a nameplate.

D. Warning Labels:
1. Label each switchboard with a warning label in accordance with NFPA70 and NFPA 70E.

E. Identify field-installed conductors, interconnecting wiring, and components.

F. Instruction Sign: Provide clear, detailed, written instructions, permanently attached to the electrical gear being served by it for staff reference.

G. One-Line: Provide a laminated, color-coded, large-format one-line diagram showing the new work is to be provided and installed in the associated electrical room.

3.04 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 Division 26 Section "Overcurrent Protective Device Coordination Study."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NECA 400. 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 switchboard. Remove necessary panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 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.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416
PANELBOARDS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES:

A. Lighting and appliance branch-circuit panelboards.

B. Dused Lighting and Appliance Branch-Circuit Panelboards.

1.02 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device

1.03 ADMINISTRATIVE REQUIREMENTS

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. Equipment indicated herein are NATIONAL ACCOUNT items purchased by the Owner or General Contractor as determined by the Owner prior to bid call, and received, store, and installed by the General Contractor.

C. The pre-manufactured electrical products shall be purchased from the approved supplier: Custom Designed Controls (CD Controls), 55 Gateway Drive, Lavonia, GA 30553, Tel: (706) 356-3025, Fax: (706) 356-0329

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.

C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section “Overcurrent Protective Device Coordination Study”

D. Qualification Data: For qualified testing agency.

E. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: Submit final panelboard directories.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for panelboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

H. CD Controls “Process and Procedure” manual for Contractors review and use.

I. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.06 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.

1.07 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 23 deg F (minus 5 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 occupied facilities. Refer to Division 26 Section “General Electrical Requirements” for allowable outages.

1.08 WARRANTY

A. Warranty Period: Five years from date of Substantial Completion.

1.09 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

A. The only acceptable manufacturer of panelboards is General Electric Co. A-series Type AE or AQ.

B. Enclosures: Flush- or surface-mounted cabinets as noted.
   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 and/or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
      e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
   2. Hinged Front Cover: Entire front trim hinged to box.
   3. Door: Standard door with concealed hinges, within hinged trim cover. Secured with vault-type latch with tumbler lock; keyed alike.

4. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.
5. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and/or bottom as required.

D. Buses: Three phase, four wire unless otherwise indicated.
1. Phase, and Neutral Buses:
   a. Material:
      1) Tin-plated aluminum.
         a) Hard-drawn copper, 98 percent conductivity,may be substituted if provided at no additional cost.
      2) Hard-drawn copper, 98 percent conductivity.
   b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of panelboard's sections.
      1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus
2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
   a. Material: Hard-drawn copper, 98 percent conductivity
   b. Size: Minimum-size required by UL 67
3. Split Bus: Vertical buses divided horizontally into individual vertical sections.

E. Line-Side Conductor Connectors (Lugs):
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
2. Material: Same as bus material.
3. Capacity rating: Same as associated bus.
4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.

F. Feed-Through Lugs:
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
2. Location: Locate at opposite end of bus from line side lugs or main device.
3. Material: Same as line side conductor connectors.
4. Capacity rating: Same as associated bus.
5. Type: Same as line side conductor connectors.

G. Subfeed lugs (Double Lugs):
1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

2. Location: Locate at same end of bus as incoming lugs or main device.
3. Material: Same as line side conductor connectors.
4. Capacity rating: Same as associated bus.
5. Type: Same as line side conductor connectors.

H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating – Fully Rated: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. See manufacturers above.

B. Panelboards: Circuit breaker type: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. See manufacturers above.

B. Arc Flash Mitigation
1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical type unless otherwise indicated on Drawings, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    1) Mounting: Integral
e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

PART 3 EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Wall-Mounted Panelboards: Install panelboards on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For panelboards not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

E. Install filler plates in unused spaces.

F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with a nameplate.

C. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.
   1. Exception: Do not install NFPA 70 working clearance requirements on flush panelboards and similar equipment in finished spaces.

D. Identify field-installed conductors, interconnecting wiring, and components; complying with Division 26 Section "Identification for Electrical Systems."

E. Panel Directories
   1. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
   2. Noted the date the directory was created/updated.
   3. Create directory after loads have been balanced.
   4. Replace existing directories with revised type written directories indicating changes.

3.04 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262600
POWER DISTRIBUTION UNITS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes freestanding, prepackaged, power distribution units for transforming, conditioning, and distributing electrical power.

1.02 SUBMITTALS

A. Product Data: For power distribution units. Include system description, ratings, capacities, and performance characteristics.

B. Shop Drawings: Include dimensioned plans, sections, and elevations. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Product Certificates: For each type of power distribution unit, signed by product manufacturer.

D. Manufacturer Seismic Qualification Certification: Submit certification that power distribution units, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   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.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.
   1. For each factory test of power distribution units.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For power distribution units to include in emergency, operation, and maintenance manuals.

1.03 DEFINITIONS

A. SPD: Surge Suppression Device.

B. UPS: Uninterrupted power supply.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain a service center capable of providing training, parts, and emergency on-site repairs in less than eight hours maximum response time.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain power distribution unit and associated components specified in this Section from a single manufacturer with responsibility for entire power distribution unit installation.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.

B. Store equipment in spaces with environments controlled within manufacturer's ambient temperature and humidity tolerances for non-operating equipment.

1.06 WARRANTY

A. Manufacturer’s standard form in which manufacturer agrees to repair or replace components and/or products of the Power Distribution Unit that fail in materials or workmanship within that specified warranty period.

B. Warranty Period: Cost to repair or replace any parts or product for [one] <Insert Number> year(s) from date of substantial Completion.

C. Special Warranty Period: Extend the manufacturer’s standard form in which manufacturer agrees to repair or replace components and/or products of the Power Distribution Unit that fail in materials or workmanship within the specified warranty period for [three] <Insert Number> years in addition to the standard warranty period.

1.07 COORDINATION

A. Coordinate size and location of concrete bases with actual power distribution unit provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate layout and installation of power distribution units with access flooring for proper support and seismic restraint of units.

C. Coordinate layout and installation of power distribution units with Owner's equipment.
   1. Meet jointly with electronic equipment representatives and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute record to other participants.
   3. Adjust arrangements and locations of power distribution units to accommodate and optimize arrangement and space requirements of equipment.

1.08 PROJECT CONDITIONS

A. Environmental Conditions: Units shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability.
   1. Storage Temperature Range: Minus 67 to plus 185 deg F (Minus 55 to plus 85 deg C).
   2. Operating Temperature Range: 32 to 104 deg F (0 to 40 deg C).
   3. Relative Humidity Range: 0 to 95 percent, noncondensing.
   4. Altitude: Sea level to 3600 feet (1100 m) above sea level.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers:
   1. ABB.
   2. Controlled Power Company.
   3. Eaton Corporation.
   4. Square D; Schneider Electric.
   5. Vertiv.

2.02 MANUFACTURED UNITS

A. Description: Integrated and coordinated assembly of power-line-conditioning and distribution components packaged in a single cabinet or modular assembly of cabinets. Include the following components:
   1. Input-power, circuit-breaker section.
   2. Isolation transformer.
   3. SPD system.
   4. Output panelboard(s).
   5. Alarm, monitoring, and control system.

B. Provide units that are constructed to withstand seismic forces specified in Division 26 Section "Seismic Controls for Electrical Systems."

C. Unit Capacity Rating: Unit shall carry indicated rms kilovolt-ampere load continuously without exceeding rated insulation temperature for the following input voltage and load current:
   1. Input Voltage: Within rated input-voltage tolerance band of unit.

2. Load Current: Minimum of 3.0 crest factor and 85 percent total harmonic distortion.

2.03 INPUT-POWER, CIRCUIT-BREAKER SECTION

A. Description: 3-pole, shunt-tripped, thermal-magnetic-type circuit breaker, rated for indicated interrupting capacity and 125 percent of input current of unit at 100 percent rated load.
1. Dual-Input Units:
a. Two input circuit breakers arranged to provide transfer between two input-voltage sources.
b. Controls and interfaces to allow both open- and closed-transition transfer between two input-voltage sources.
c. Use a 120-V permissive signal from both upstream voltage sources to indicate acceptable conditions for closed-transition transfer.
d. Open second circuit breaker automatically after closed-transition transfer is competed.

2.04 ISOLATION TRANSFORMER SECTION

A. Description: Dry-type, electrostatically shielded, three-phase, common-core, convection-air-cooled isolation transformer.
1. Comply with UL 1561.
2. Cores: Grain-oriented, non-aging silicon steel, one leg per phase.
3. Coil Material and Insulation: Delta-Wye connected copper windings with a 220 deg C insulation class.
4. Temperature Rise: Designed for 150 deg C rise above 40 deg C ambient.
5. Output Impedance: 3.5 plus or minus 0.5 percent.
6. Regulation: 2 to 4 percent maximum, at full-resistive load; 5 percent maximum, at rated nonlinear load.
7. Taps: 6 full-capacity compensation taps at 2.5 percent increments; 2 above and 4 below nominal voltage.
8. Full-Load Efficiency: Minimum 96 percent at rated load.
9. Magnetic-Field Strength External to Transformer Enclosure: Less than 0.1 gauss at 450 mm.
10. Audible Noise: Comply with NEMA ST 20.
11. Electrostatic Shielding: Independently shield each winding with a double-copper, electrostatic shield arranged to minimize interwinding capacitance.
a. Coil leads and terminal strips shall be arranged to minimize capacitive coupling between input and output connections.
b. Shield Terminal: Separate, and marked "Shield" for grounding connection.
c. Capacitance: Limit capacitance between primary and secondary windings to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.
d. Common-Mode Noise Attenuation: 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
e. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.
12. Neutral Rating: 1.732 times the system full-load ampere rating.

2.05 SPD SYSTEM

A. Description: Integrated SPD system complying with Division 26 Section "Panelboards," to protect unit panelboard, and having the following features:
   1. Disconnect Device: Manual, three-pole, fused disconnect switch to de-energize SPD system while permitting power distribution units to continue operation. Fuses are rated at 200-kA interrupting capacity.
   2. Nonlinear Loading: System shall accommodate rated-load current with a minimum 3.0 crest factor and 85 percent total harmonic distortion.

2.06 OUTPUT PANELBOARDS

A. Description: Panelboards complying with Division 26 Section "Panelboards" except for mounting provisions. Mount in front of power distribution units behind flush doors. Include the following features:
   1. Construction: 42 pole, 240 V, 3 phase; capable of accepting branch circuit breakers rated to 100 A.
   2. Panelboard Rating: 225 A, with main circuit breaker.
   3. Panelboard Phase, Neutral and Ground Buses: Copper, with neutral bus at least 1.732 times the nominal phase bus rating.
   4. Isolated Ground Bus: Copper, adequate for branch-circuit equipment ground conductors; insulated from supports.
   5. Branch Circuit Breakers: Bolt-on.
   6. Cable Racks: Removable and arranged for supporting and routing cables for panelboard entrance.
   7. Access Panels: Arranged so additional branch-circuit wiring can be installed and connected in the future.

2.07 POWER DISTRIBUTION UNIT CONTROLS

A. Include the following control features:
   1. Ground-fault protection with automatic system shutdown.
   2. Auxiliary Control Outputs: Lighting contactors and building energy management system.

2.08 MONITORING, STATUS, AND ALARM ANNUNCIATION

A. Description: Microprocessor-based monitoring, status, and alarm annunciation panel mounted flush in front of power distribution unit to provide status display and failure-indicating interface for the following:
   1. Power Monitoring:
      a. Input Voltage: Line to line, rms.
      b. Output Voltage: Line to line, rms.
      c. Output Voltage: Line to neutral, rms.
      d. Output current each phase.
   2. Status Indication: Unit on.
   3. Alarm Annunciation:
      a. High temperature.
      b. High and low input voltage.
      c. High and low output voltage.

d. Phase loss.
e. Ground fault.
f. Frequency.
g. Phase rotation.
h. SPD module failure.

4. Audible Alarm and Silencing Switch: Alarm sounds when alarm indication occurs. Silencing switch shall silence audible alarm but leave visual indication active until failure or other alarm conditions are corrected.

2.09 SOUND LEVEL

A. General: Fully assembled products comply with minimum sound-level requirements in NEMA ST 20 for transformers of corresponding ratings when factory tested according to IEEE C57.12.91.

2.10 FINISHES

A. Manufacturer's standard finish over corrosion-resistant pretreatment and primer.

2.11 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests shall comply with referenced standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Arrange power distribution units to provide adequate access to equipment and circulation of cooling air.

C. Anchor or restrain floor-mounting power distribution units according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Identify equipment and install warning signs according to Division 26 Section "Identification for Electrical Systems."

3.02 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Separately Derived Systems: Make grounding connections to grounding electrodes as indicated; comply with NFPA 70.

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for circuit breakers, molded case; and for transformers, dry type, air cooled, low voltage, small. Certify compliance with test parameters.
   2. Perform functional tests of power distribution units throughout their operating ranges. Test each monitoring, status, and alarm function.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of conductor and bus connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
   3. Prepare a certified report identifying connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Verify that power distribution units are installed and connected according to the Contract Documents.
   2. Verify that electrical wiring installation complies with manufacturer's submittal and with written installation requirements in Division 26 Sections.
   3. Complete installation and startup checks according to manufacturer's written instructions.

3.05 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Adjust power distribution units to provide optimum voltage to equipment served throughout normal operating cycle of loads served. Record input and output voltages and adjustment settings, and incorporate into test results.

3.06 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power distribution units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262600

SECTION 262726
WIRING DEVICES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following:
   1. Receptacles: Single, duplex, USB/duplex, USB-only, twist-lock, ground-fault circuit interrupters (GFCI), surge protective device (SPD), isolated ground (IG) and tamper resistant (TR).
   2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary, pilot light and lighted toggle.
   3. Device Wall Plates.
   4. Service/Power Poles and Multi-Outlet Assemblies.
   5. Emergency Power Off Buttons

1.02 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. IG: Isolated Ground

C. PIR: Passive Infrared.

D. RFI: Radio Frequency Interference

E. SPD: Surge Protective Device

F. USB: Universal Serial Bus

G. TR: Tamper Resistant

1.03 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

B. Product data for the following products:
   1. Provide manufacturer’s catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, cover plates, power poles, and multi-outlet assemblies.

C. Shop drawings for:
   1. List of legends and description of materials and process used for pre-marking wall plates.

D. Field quality-control test reports.

E. Operations and Maintenance Data:

1. [Provide re-ordering instructions and directions for replacement surge modules for SPD receptacles.]

F. Warranty: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.

B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.

C. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
2. Marked for intended use.

D. Comply with NFPA 70.

1.05 COORDINATION

A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

1.06 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. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.
2. Service/Power Poles: One for every 10 of each type installed, but no fewer than one of each type.

1.07 SPARES

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.
2. Service/Power Poles: One for every 10 of each type installed, but no fewer than one of each type.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Receptacles and Switches:
      a. Cooper Wiring Devices.
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Mfg. Company Inc.
      d. Pass & Seymour/Legrand; Wiring Devices Div.
   2. Multioutlet Assemblies:
      a. Hubbell Incorporated; Wiring Device-Kellems.
      b. Wiremold Company (The).
   3. Service/Power Poles:
      a. Hubbell Incorporated; Wiring Device-Kellems.
      b. Pass & Seymour/Legrand; Wiring Devices Div.
      c. Square D/Groupe Schneider NA.
      d. Thomas & Betts Corporation.
      e. Wiremold Company (The).
   4. Emergency Power Off Buttons:
      a. GE Industrial.
      b. Square D/Groupe Schneider NA.
      c. Eaton.

B. In other Part 2 articles below, where lists of manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:
   1. Additional Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph “[Available] Manufacturers” above.

2.03 FINISHES

A. Color:
   1. Wiring devices connected to normal power systems: White , unless otherwise indicated or required by NFPA 70. Cover plates: The same as the wiring device.
   2. Isolated-Ground receptacles: Orange, with an orange triangle on its face. Cover plates: As selected by the Architect and engraved with “ISOLATED GROUND” at the top with white filler in the engraving.

B. Manufacturer's model numbers listed are to establish the quality of the wiring devices. Coordinate the proper suffixes in order to provide the correct color as specified above.

2.04 CONVENIENCE RECEPTACLES:

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.

B. Duplex convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex	Single
Cooper	5362	351
Hubbell	5352A	HBL5361
Leviton	5352	5261
Pass & Seymour	5362	5361

C. Duplex tamper resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	R5362
Hubbell	HBL8300SGA
Leviton	8300-SGG
Pass & Seymour	TR5362

D. Duplex weather resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	TWR270
Hubbell	5362WR
Leviton	WBR20
Pass & Seymour	WR5862

E. Twist-Locking type receptacles: NEMA L5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, self-grounding.

Manufacturer	Single
Cooper	L520R
Hubbell	HBL2310
Leviton	2310
Pass & Seymour	L520-R

F. USB/duplex convenience receptacles: NEMA 5-20R, 125V, 20A, tamper resistant, 3-wire, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding; with integral USB charger having two ports, USB 2.0 compatible, 5VDC, 3A output (min).

Manufacturer	Single
Cooper	TR7756
Hubbell	USB20X2
Leviton	T5832

Pass & Seymour	TR5362USB

G. Automatically Controlled receptacles: Where indicated on drawings, provide device type from other applicable category, along with marking for controlled receptacles as required by the current version of the NEC. In the case where the NEC is not applicable to the project, the device shall still be provided with this marking. In that case, the NEC is providing the standard for the marking and this specification is requiring it to be marked above and beyond the application of the code.

2.05 GFCI RECEPTACLES

A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles downstream on the same circuit.

Manufacturer	Specification Grade
Cooper	VGF2
Hubbell	GF20LA
Leviton	T7899-H
Pass & Seymour	2095

B. Ground fault circuit interrupter type weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles downstream on the same circuit.

Manufacturer	Specification Grade
Cooper	WRVGF20
Hubbell	GFTR20
Leviton	W7899
Pass & Seymour	2095TRWR

C. Ground fault circuit interrupter type tamper and weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles downstream on the same circuit.

Manufacturer	Specification Grade
Cooper	TWRVGF20
Hubbell	GFTR20
Leviton	W7899-T
Pass & Seymour	2095TRWR

D. Ground fault circuit interrupter with Blank Face: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles downstream on the same circuit.

Manufacturer	Specification Grade
Cooper	VGFD20
Hubbell	GFBF20
Leviton	7595
Pass & Seymour	2085

E. Ground fault circuit interrupter with Isolated Ground: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles downstream on the same circuit.

Manufacturer	Specification Grade
Cooper	N/A
Hubbell	N/A
Leviton	2095IGTRW
Pass & Seymour	N/A

2.06 ISOLATED GROUND RECEPTACLES

A. Isolated ground receptacles: Heavy Duty Specification grade NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, furnished with a green pigtail connected to the grounding contact, and grounding contacts electrically isolated from the mounting strap.

Manufacturer	Straight Blade
Cooper	IG5362
Hubbell	IG5352
Leviton	5362-IG
Pass & Seymour	IG5362

2.07 SWITCHES

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide switches equivalent to those specified for 20A, but rated for 15A.

B. Switches: Heavy Duty Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	AH1221	AH2221	AH3221	AH4221
Hubbell	1221	1222	1223	1224
Leviton	1221-2	1222-2	1223-2	1224-2
Pass & Seymour	CSB20AC1	CSB20AC2	CSB20AC3	CSB20AC4

C. Pilot Light switches: 20A, single pole switch with red neon lighted handle. Toggle shall be illuminated when the switch is in the "ON" position.

Manufacturer	1 Pole	2 Pole	3 Way
Cooper	AH2221PL	AH222PL	AH2223PL
Hubbell	HBL1221PL	HPL1222PL	HBL1223PL
Leviton (120V)	1221-R	1222-PLR	1223-PLR
Leviton (277V)	1221-7PLR (277V)	1222-7PLR	1223-7PLR
Pass & Seymour	PS20AC1-RSL	PS20AC2-RSL	PS20AC3-RSL

D. Key operated light switches: Same as standard light switches except toggle handle shall be operated by a factory provided key.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	221L	2222L	2223L	2224L
Hubbell	HBL1221L	HBL1222L	HBL1223L	HBL1224L

Leviton	1221-2KL	122202KL	1223-2KL	1224-2KL
Pass & Seymour	PS20AC1-L	PS20AC2-L	PS20AC3-L	PS20AC4-L

2.08 COVER PLATES

A. Damp Location Weatherproof Receptacle Cover Plates: UL-listed Wet Location (cover closed, not in use); die-cast, gasketed (factory-installed) self-closing covers, for vertical mounting:

Manufacturer	[Vertical]
Cooper	966
Hubbell	RW51040
Leviton	4978
Pass & Seymour	4512

B. Wet Location Weatherproof Receptacle Cover Plates (Outlet Box Hood): NEMA 3R weather resistant recessed or flush mount, die cast aluminum lockable cover. Configure cover for horizontal mounting of receptacle or as indicated otherwise. Back box must be suitable for conduit connections. Coordinate back box with wall depth.

Manufacturer	Horizontal
Thomas & Betts	CKMU
Eaton	WIUMV-1
Hubbell	WP26MH
Leviton	IUM1H-GY

C. Damp and Wet Location Weatherproof switch cover plates: Fabricated of cast aluminum or cast zinc, sealed water-tight and UL listed for wet locations.

Manufacturer	1 Gang	2 Gang
Appleton	FSK	--
Raco	5100 Series	--
Steel City	SW Series	--

D. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.
1. Plate securing screws: Metal with head color to match finish plate.
2. Material for Finished Spaces: Brushed stainless steel Type 302 Smooth plastic, minimum 0.10-inch thick. Refer to “Finishes” above for color..
3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.
4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

2.09 SERVICE/POWER POLES

A. Service/Power Poles: Extruded aluminum with finish selected by architect raceway, internal barrier to separate power conductors from communications cables, ceiling trim plate, carpet/tile floor plate as required for floor material, a minimum of (2) pre-wired duplex receptacles connected to a junction box on the top of the pole, removable plate with knockouts for (2) telephone jacks and (2) data jacks, and a “pop-off” cover, removable without tools. Power poles shall be at least 6 inches taller than the ceiling but not less than 8’-6” tall.

Manufacturer	Extruded Aluminum
Hubbell	HBL PP10A
Pass & Seymour	--

Square D	--
Thomas & Betts	--
Wiremold	AMDTP-4 Series

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.

C. Connect wiring devices by wrapping conductors around screw terminals. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.

E. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.

F. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.

G. Install switches with OFF position down.

H. Install cover plates on all switches, receptacles, and blank outlets.

I. Locate wiring devices so that the cover plate does not have to be cut to be installed.

J. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.

K. Install cover plates after the wall has been finished (painted, wall paper, etc.).

L. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

M. Provide Hospital Grade receptacles in, patient rooms, surgery rooms, special procedure rooms, exam rooms, treatment rooms, radiology rooms and other patient care and treatment areas. Provide specification grade receptacles in all other areas unless otherwise noted.

N. Provide safety-type, tamper-resistant receptacles in all areas where receptacles are mounted less than 5’-6” AFF and are easily accessible to children.

O. Provide safety-type, tamper-resistant receptacles in psychiatric patient rooms. Provide tamperproof screws on faceplates of all wiring devices in psychiatric patient rooms.

P. Provide engraved nameplate on emergency off buttons.

Q. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6' or sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.

R. Provide type and quantity of normally open and/or normally closed contacts for emergency off buttons to meet the sequence of operations shown.

S. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

3.02 GENERAL

A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the Architect.

B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.

C. Provide twist-locking type receptacles or other special type receptacles where indicated on the Drawings.

3.03 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that floor boxes are adjusted properly and are flush with the finished surface.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that openings in access floor are in proper locations.

3.04 PREPARATION

A. If required, provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from in and around outlet boxes.

3.05 MOUNTING HEIGHTS

A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".

B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.
   1. Receptacles:

a. General:
   1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
   2) Where Installed horizontally, install neutral slot mounted at the top.
b. Above counters:
   1) Mount vertically.
c. Mechanical and electrical equipment rooms and janitors closets:
   1) Mount horizontally.
d. Weatherproof exterior receptacles:
   1) Mount horizontally.
e. GFCI receptacles: Same as general receptacles.
f. Isolated ground receptacles: Same as general receptacles.
g. SPD receptacles: Same as general.
h. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.

2. Switches:
   a. Above counters: Same as for receptacles.
   b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.
   c. Walls with wainscoting: As indicated on the drawings.
3. Telephone/Data Outlet Boxes:
   a. General: Match mounting height of adjacent wiring device listed above.

3.06 IDENTIFICATION

A. Label all devices fed down stream of GFCI protected receptacles as “GFCI PROTECTED”.

B. Comply with Division 26 Section "Identification for Electrical Systems."
   1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:
      a. Hot, stamped or engraved machine printing with white-filled lettering on face of plate.
      b. Durable wire markers or tags inside outlet boxes.
      c. Permanent-ink marker, hand-printed legibly, inside outlet boxes.
      d. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.
      e. Adhesive Film Label with Clear Protective Overlay, but with letter/number height of 1/4 inch, on face of plate, for exterior and damp/wet locations.

3.07 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

D. Test all wiring devices for electrical continuity and proper polarity of connections.

E. Test each GFCI receptacle device for proper operation.

F. Correct wiring devices incorrectly installed.

G. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

3.08 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.09 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

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SECTION 262813
FUSES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600-V ac and less for use in:
      a. Enclosed switches
   2. Spare-fuse cabinets.

1.02 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.03 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.04 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.05 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper Bussmann, Inc.
   2. Edison Fuse, Inc.
   3. Mersen Electrical Power
   4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install plug-fuse adapters in Edison-based fuseholders and sockets. Ensure that adapters are irremovable once installed.

D. Install spare-fuse cabinet(s).

3.02 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits:
      a. Class RK1 time delay
      b. [Class RK5, time delay]
   2. Other Branch Circuits:
      a. Class RK1, time delay
      b. [Class RK5, time delay]
      c. [Class J, fast acting]
      d. [Class J, time delay]

END OF SECTION 262813

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SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Shunt trip switches.
   4. Molded-case circuit breakers (MCCBs).
   5. Molded-case switches.
   6. Enclosures.

1.02 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.06 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.07 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 PRODUCTS AND MATERIALS

2.01 FUSIBLE SWITCHES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.02 NONFUSIBLE SWITCHES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 SHUNT TRIP SWITCHES

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. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; 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 source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:
1. Oil tight key switch for key-to-test function.
2. Oil tight red ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Form C alarm contacts that change state when switch is tripped.

2.04 MOLDED-CASE CIRCUIT BREAKERS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. 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.

H. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; 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.
   5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
   9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   10. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
   11. Electrical Operator: Provide remote control for on, off, and reset operations.

2.05 MOLDED-CASE SWITCHES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:
1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.06 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. 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.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

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SECTION 263100
PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. Photovoltaic system requirements.

B. Photovoltaic modules.

C. Photovoltaic module mounting system.

D. Photovoltaic combiner boxes.

E. Photovoltaic inverters.

F. Charge controllers.

G. Monitoring system.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for photovoltaic system components.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Roof-Mounted Arrays: Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   4. Notify Contract Administrator of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Rebates and Incentives: Assist in preparing and submitting documentation as required for Owner to secure funds from available federal, state, and utility company rebate and incentive program. Notify Owner of any time constraints affecting program qualification.
   1. Include copies of documentation with submittals.

C. Utility Interconnection:
   1. Assist in preparing and submitting documentation as required for securing utility interconnection agreement between Owner and Utility Company.
      a. Include copies of documentation with submittals.
   2. Preinstallation Meeting: Convene one week prior to commencing work of this section to review interconnection requirements and details with Utility Company representative.
   3. Coordinate with Utility Company to provide utility metering suitable for system requirements.
   4. Arrange for inspections and secure permits necessary to obtain Utility Company approval of system.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, details, and description of operation.

C. Product Data: Provide manufacturer's standard data sheets for each product. Include ratings, configurations, operating characteristics, electrical characteristics, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

D. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.
   1. Include proposed locations of roof penetrations and proposed methods for sealing.

E. Design Data:
   1. Include structural calculations certified by structural engineer, for equipment and mounting system.
   2. Include electrical calculations certified by electrical engineer for array and associated equipment.

F. Certify that work of this section does not void roof warranty.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

H. Manufacturer’s detailed field-testing procedures.

I. Manufacturer's detailed startup procedures.

J. Rebate and incentive documentation.

K. Utility interconnection documentation.

L. Source quality control test reports.

M. Field quality control test reports.
   1. Include manufacturer's field reports.

N. Structural Engineer's Qualification Statement.

O. Electrical Engineer's Qualification Statement.

P. Manufacturer's Qualification Statement.

Q. Installer's Qualification Statement.

R. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

S. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

T. Maintenance contracts.

U. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

V. Software: One copy of software provided under this section.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with Utility Company requirements for interconnection.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Structural Engineer Qualifications: Registered structural engineer licensed in the State in which the Project is located.

E. Electrical Engineer Qualifications: Registered electrical engineer licensed in the State in which the Project is located experienced in the design of photovoltaic systems.

F. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.

G. Installer Qualifications: Company specializing in performing the work of this section; minimum five years experience with photovoltaic systems of similar size, type, and complexity.
   1. Licensed in the State in which the Project is located to install photovoltaic systems.
   2. Manufacturer's authorized installer.
   3. Supervisor: North American Board of Certified Energy Practitioners (NABCEP) certified PV Installer or three years experience supervising the installation of photovoltaic systems.

H. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
   1. Contract maintenance office located within 100 miles of project site.

I. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.06 WARRANTY

A. Specified warranties indicate minimum requirements. Provide additional warranties or extended warranty periods where required to qualify for rebate and incentive programs.

B. Photovoltaic Modules:
   1. Provide minimum ten year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
   2. Provide linear manufacturer warranty guaranteeing minimum 90 percent of rated power output for 10 years and minimum 80 percent of rated power output for 25 years.

C. Photovoltaic Module Mounting System: Provide minimum 10 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

D. Photovoltaic Combiner Boxes: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

E. Photovoltaic Inverters: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

F. Charge Controllers: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers:

B. Basis-of-Design: As listed in schedule or comparable products by one of the following:
   1. Photovoltaic Modules – Crystalline Silicon:
      a. Trina Solar Co., Ltd.
      b. Jinko Solar Co., Ltd.
      c. Hanwaha Q Cells
      d. Canadian Solar
      e. SunPower
      f. REC Solar
      g. Silfab Solar
   2. Photovoltaic Module Mounting System:
      a. Cooper B-Line, a division of Cooper Industries
      b. IronRidge
      c. K2 Systems
      d. S-5! Attachment Solutions
      e. PHP Systems/Design
      f. Unirac, Inc.
   3. Photovoltaic Combiner Boxes:
      g. SMA America, LLC
      h. SolarBOS (Terrasmart)
      i. Yaskawa Solectria Solar
      j. ABB
   3. Photovoltaic Inverters:

a. Schneider Electric
b. SMA America, LLC
c. Yaskawa Solectria Solar
d. SolarBOS (Terrasmart)
e. Canadian Solar

4. Charge Controllers:
   a. Outback Power Technologies, Inc
   b. Schneider Electric
5. Monitoring System:
   a. Schneider Electric
   b. SMA America, LLC
   c. Yaskawa Solectria Solar
6. Rapid Shutdown Devices
   a. Schneider Electric
   b. Outback Power Technologies, Inc
   c. SMA America, LLC

C. Source Limitations: For each type of component, furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 PHOTOVOLTAIC SYSTEM REQUIREMENTS

A. Provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.

B. System Description:
1. Photovoltaic array is roof-mounted in location indicated on the drawings.
2. Orientation of array is as indicated on the drawings.
3. Photovoltaic DC system is ungrounded.
4. System includes interconnection with utility grid (grid-tied system).
5. Utility metering configuration: Net metering.
6. System includes battery storage system.
7. System includes DC system surge protection.
8. System includes monitoring system.
9. Owner intends to secure funds from available federal, state, and utility company rebate and incentive program.

C. Capacity:
1. Total Nominal Rated Power Output of Array: Equal to or greater than the rated output of the basis of design array as indicated on E600, rated under Standard Test Conditions (STC).
2. Nominal Rated Power Output of Individual Modules: Equal to or greater than the rated output of the basis of design module as indicated on E600, rated under Standard Test Conditions (STC).

D. Size:
1. Array: Designed to fit within the area designated on the drawings.
2. Individual Modules: Size is not critical.

E. Appearance:
1. Only systems with similar appearance to basis of design system; or will be considered.
2. Arrange array such that modules are aligned with uniform spacing.

3. Make no alterations affecting appearance of building exterior or interior without approval of Architect.
4. Final determination of acceptable appearance is by Architect.

F. Fire Resistance Rating: Provide photovoltaic module and mounting system combination that together with the roof covering form a system listed in accordance with UL 61730 to provide a fire rating equal to or better than the required fire rating of the roof.

G. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.
1. Comply with local building code and ASCE 7.
2. Include structural calculations demonstrating compliance with submittals.

H. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.

I. Provide products listed, classified, and labeled as suitable for the purpose intended.

J. Provide photovoltaic system and associated components that qualify for available federal, state, and utility company rebate and incentive programs.

K. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.

L. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with NFPA 70.

M. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown in accordance with NFPA 70.

N. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

O. Arrange array to provide adequate access to rear of string(s) for maintenance.

P. Arrange array to minimize shading during peak production periods.

Q. Roof-Mounted Arrays:
1. Arrange array such that normal roof drainage is not affected.
2. Arrange array to maintain required safety clearances from edges of roof as required by authority having jurisdiction.
3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
4. Arrange array to avoid spanning of expansion joints.

2.03 PHOTOVOLTAIC MODULES

A. Module Types: Monocrystalline silicon modules; polycrystalline modules will not be considered for this project.

B. General Requirements:

1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with IEC 61215-1 and IEC 61215-2 and listed as complying with UL 61730.
2. Crystalline Silicon Photovoltaic Modules: Comply with IEC 61215-1-1.
3. Frame: Anodized aluminum.
4. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
5. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
6. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.04 BALANCE OF SYSTEM COMPONENTS

A. Photovoltaic Module Mounting System:
1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.
2. Support Structure and Associated Hardware Materials: Use aluminum or galvanized steel or stainless steel.
3. Roof-Mounted Arrays:
   a. Acceptable System Types: Either non-penetrating or penetrating systems complying with specified requirements will be considered for this project
   b. Provide system compatible with the roof at the installed location.
   c. Module Tilt Angle: As indicated on drawings or as required to provide maximum energy production for installed location.
   d. Provide minimum clearance of 3 inches between roof and module for air circulation and drainage.

B. Photovoltaic Combiner Boxes:
1. Provide combiner box(es) for termination of strings as indicated or as required for the array configuration installed.
2. Combiner Boxes: Rated for 600 V DC; current ratings suitable for connected strings; equipped with circuit breakers; listed as complying with UL 1741.
3. Fuseholders: Touch-safe; suitable to accept fuses indicated.
4. Number of Input Circuits: As indicated or as required for termination of strings with minimum of 25 percent spare capacity for future expansion.
5. Enclosure: NEMA 250, Type 3R minimum, unless otherwise indicated.
6. Provide integral load-break rated disconnect.
7. Provide with capability of current monitoring for individual strings.

C. Photovoltaic Inverters:
1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741; furnished with the following features:
   a. Maximum power point tracking (MPPT).
   b. LCD display.
   c. Integral AC disconnect.

d. Integral DC disconnect.
e. Integral DC ground fault detection and interruption (GFDI).
f. Communications Interface: As required for connection to system indicated.

3. Grid-Tied Inverters: Comply with IEEE 1547, including over/under grid voltage and frequency protection, and anti-islanding protection to automatically disconnect upon loss of utility power and to remain disconnected until utility power restoration has been maintained for five minutes.
4. Total Harmonic Distortion: Less than five percent.
5. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.

D. Enclosed Switches:
1. Switches for DC System: Rated for 600 V DC.
2. Switches Connected to Supply Side of Service Disconnecting Means: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Charge Controllers: Suitable for the requirements of the connected battery storage system; no readily accessible user adjusting means; listed as complying with UL 1741.

F. Batteries: Comply with Section _____.

G. Surge Protective Devices for DC System:
1. Rated for 600V DC.
2. Listed and labeled as complying with UL 1449, Type 1.
3. Surge Current Rating: Not less than 50 kA per mode.
4. UL 1449 Nominal Discharge Current (I-n): 20 kA.

H. Molded-Case Circuit Breakers and Switches for DC System: Rated for 600 V DC; listed as complying with UL 489B.

I. Fuses:
1. Fuses for DC System: Rated for 600 V DC.
2. Fuses for Protection of Photovoltaic Strings and Arrays: Photovoltaic fuses listed as complying with UL 2579,indicator type.

J. Monitoring System:
1. Provide a system to monitor photovoltaic system performance including all sensors, dataloggers, connections, software, equipment and accessories necessary for a complete operating system.
2. System communications interfaces to be wired or wireless with compatible interconnected components.
3. Provide suitable raceway, minimum 3/4 inch; trade size, for all required wired connections.
4. System to monitor and record, in 15 minute intervals:
   a. Inverter status.
   b. Instantaneous power (kW).
   c. Cumulative energy production (kWh).
   d. Irradiation.
   e. Ambient temperature.
   f. Module cell temperature.

g. Wind speed and direction.
h. Current monitoring for individual strings.

5. Energy Production Meter: Revenue grade, with accuracy of 0.5% or higher.
6. System real-time and historical data to be accessible from the following locations:
   a. Personal computer(s) via internet connection.
   b. Remote display(s), quantity and location as indicated on the drawings.
7. System to provide alarm notification via e-mail or instant message.
8. System to be compatible with third party monitoring service to be selected by Owner.

2.05 SOURCE QUALITY CONTROL

A. Factory test the following products to verify operation and performance characteristics Include test reports with submittals.
   1. Photovoltaic modules.
   2. Photovoltaic inverters.
   3. Charge controllers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Use open circuiting, short circuiting, or opaque covering to disable modules, array, or portions of array prior to installation and service.

B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install photovoltaic system in accordance with NECA 412.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Provide required seismic controls in accordance with Section 26 05 48.

F. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the roof.

G. Circuiting Requirements.:
   1. Wiring Methods:
      a. Unless otherwise indicated, useexposed type USE-2/RHH/RHW-2 single-conductor cable or listed photovoltaic wire (not routed inside building for module interconnections.
      b. Unless otherwise indicated, use type USE-2/RHH/RHW-2 single-conductor cable or listed photovoltaic wire in suitable raceway for wiring between string(s) and combiner box(es), transition junction box(es), inverter(s), point of interconnection.
      c. Secure exposed cables in accordance with NFPA 70. Where possible, conceal behind array.
      d. Install cables in suitable raceway where readily accessible or where required by authority having jurisdiction.
      e. Use suitable twist-on insulated spring connectors or mechanical connectors for photovoltaic circuit splices and taps.
   2. Photovoltaic DC System Conductor Color Code:
      a. Ungrounded System:
         1) Positive: Red.
         2) Negative: Black.
   3. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.

H. Grounding and Bonding Requirements:
   1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.

I. Identification Requirements:
   1. Use identification nameplate to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate at main service disconnecting means and at each photovoltaic system disconnecting means. Verify format and descriptions with authorities having jurisdiction.
   2. Use identification nameplate to identify each photovoltaic system disconnecting means<< with text "PV SYSTEM DISCONNECT".
   3. Use identification nameplate to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with NFPA 70 and requirements of authorities having jurisdiction.
   4. Use identification nameplate to identify the information required by NFPA 70 for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.
   5. Use identification nameplate to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
   6. Where the inverter output connection is located in a panelboard on the opposite (load) end from the input feeder location or main circuit location in order to meet requirements of NFPA 70, use identification nameplate to identify the overcurrent device with the word message "Warning; Inverter output connection; Do not relocate this overcurrent device."
   7. Use warning labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position."

8. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
9. Use suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Warning: Photovoltaic Power Source" at maximum intervals of 10 feet in accordance with NFPA 70.

3.04 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B. Inspection and testing to include, at a minimum:
   1. Inspect each system component for damage and defects.
   2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
   3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.
   4. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
   5. Perform insulation resistance tests.
      a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
   6. Measure and record ambient conditions, including date and time; ambient temperature; cell temperature; solar irradiance in the module plane; and wind speed.
   7. Measure and record open circuit voltage of each string.
   8. Measure and record voltages at the inverter AC and DC inputs.
   9. Measure and record operating current for each string, sub-array, and array.
   10. Measure and record AC output power.
   11. Perform inverter functional test.
      a. Grid-Tied Inverters: Include simulation of loss of utility power and subsequent power restoration.
   12. Verify proper operation of monitoring system.

C. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

D. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
   1. Record all system operations and malfunctions.
   2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
   3. Submit detailed reports indicating inspection and testing results and corrective actions taken.

E. Repair roof or adjacent roof-mounted items damaged as a result of work of this section.

3.05 SYSTEM STARTUP

A. Provide services of a manufacturer's authorized representative to assist in performing system startup. Include manufacturer's detailed startup procedures with submittals.

B. Obtain Contract Administrator's approval prior to performing system startup.

C. Grid-Tied Systems: Obtain Utility Company's approval prior to performing system startup.

D. Prepare and start system in accordance with manufacturer's instructions.

3.06 CLEANING

A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of photovoltaic system. Training shall be on site.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of four hours of training.
   3. Instructor: Manufacturer's authorized representative or Qualified contractor familiar with the project and with sufficient knowledge of the installed system.

3.08 MAINTENANCE

A. Provide to Owner [a proposal as an alternate to the base bid] [at no extra cost] a separate maintenance contract for the service and maintenance of photovoltaic system for two years from date of Substantial Completion, to include the work described below; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

B. Conduct site visit at least once every six months to perform inspection, testing, and preventive maintenance. Conduct tests similar to those made during original field quality control testing. Submit report to Owner comparing test results with those of original tests along with evaluations and recommendations.

C. Provide trouble call-back service upon notification by Owner:
   1. Include allowance for call-back service during normal working hours at no extra cost to Owner.

END OF SECTION 263100

SECTION 263213
PACKAGED ENGINE-DRIVEN GENERATORS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES:

A. [Gas] [Diesel]-engine generator sets for [emergency] [standby] power supply with the following features and accessories:
   1. Engine-generator set.
   2. Battery charger.
   3. Starting battery
   4. Day tank.
   5. Integral base-mounted fuel tank.
   6. Muffler/silencer.
   7. Generator overcurrent and fault protection.
   8. Exhaust piping external to set.
   9. Outdoor enclosure.
   10. Remote radiator motors.
   11. Vibration isolation devices.
   12. Remote annunciator.
   13. [Unit-mounted] [Remote-mounting] cooling system.
   14. [Unit-mounted] [Remote-mounting] control and monitoring.
   15. Remote stop switch.
   16. Load bank.
   17. Load-bank remote-control panel.

1.02 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

C. LP: Liquid petroleum.

D. EPS: Emergency power supply.

E. EPSS: Emergency power supply system.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of generators and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.04 SUBMITTALS

A. Product Data: Include the following:
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Thermal damage curve for generator.
   3. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Include the following:
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Dimensioned plan and elevation drawings of engine-generator set and other components specified. [Indicate access requirements affected by height of subbase fuel tank.]
   3. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   4. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   5. Diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

C. Coordination Drawings: For each equipment room and equipment yard, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
   1. Dimensioned concrete base, outline of equipment, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
   2. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
   3. Location of structural supports for structure-supported raceways[, piping,] [after-treatment devices,] [and seismic bracing].
   4. Location and clearance of electrical equipment and raceways impacting equipment installation.
   5. Proposed routing of equipment, in shipping splits, from exterior of the building to the final installed location. Include product weights, width and height restrictions encountered along the path. Include intended construction sequencing to mitigate conflicts.
   6. Proposed routing of equipment for future removal, from within equipment room to exterior of the building without removal of non-related equipment or architectural elements.

D. Welding certificates.

E. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, including [full fuel tank], [supplied enclosure,] [external silencer,] [subbase-mounted fuel tank,] [skid-mounted load bank,] [and] each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Qualification Data:
1. For Installer.
2. For manufacturer.
3. For testing agency.

G. Source Quality-Control Reports: Including, but not limited to, the following
1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
    a. For installations where field-deployed after treatment devices are utilized to meet emission standards, provide manufacturer certification.
7. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
    a. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    b. Operating instructions laminated and mounted adjacent to generator location.
    c. Training plan.

J. Warranty

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within [200 miles (160 km)] <Insert number of miles (kilometers)> of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer. Source shall be responsible for insuring all components of system proved under this specification section, and controlled equipment within the following sections, operate together to meet project requirements including, but not limited to controls, monitoring, and selective coordination.
   1. 262313 Paralleling Low-Voltage Switchgear
   2. 262413 Switchboards
   3. 263600 Transfer Switches

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for generators including clearances between generators and adjacent surfaces and other items. Comply with indicated maximum dimensions.

G. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX for welding exhaust-[and cooling-]system piping.

H. 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.

I. Comply with NFPA [30][54 and 58]

J. Comply with NFPA 37.

K. Comply with NFPA 70.

L. Comply with NFPA 99.

M. Comply with NFPA 110 requirements for Level [1] [2], Type 10, Class “X” emergency power supply system.

N. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

O. Noise Emission: Comply with [applicable state and local government requirements] <Insert other Project criteria> for maximum noise level at [adjacent property boundaries] <Insert other critical locations> due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.06 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.

1.07 WARRANTY

A. Manufacturer’s Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.08 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide [12] <Insert number> months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

1.09 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. Fuses: One for every 10 of each type and rating, but not less than one of each.
   2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements provided in Generator Sizing Schedule on drawings, provide comparable products by one of the following, the manufacturer used as the basis of design is listed in schedule:
   1. Caterpillar; Engine Div.
   2. Cummins Power Generation, Inc
   3. MTU Onsite Energy
   4. Generac Power Systems, Inc.
   5. Rehlko (Formerly Kohler Power Systems)
   6. [Taylor Power Systems]
   7. [AKSA Power Generation]

8. <Insert manufacturer's name.>

2.02 SERVICE CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: [5 to 40 deg C] [Minus 15 to plus 40 deg C].
   2. Relative Humidity: 0 to 95 percent.
   3. Altitude: Sea level to [1000 feet (300 m)] <Insert altitude>.

B. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:
   1. [High salt-dust content in the air due to sea-spray evaporation] <Insert unusual condition>.

2.03 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.

C. Power Rating: [Prime] [Industrial] [Standby].

D. EPSS Class: Engine generator shall be classified as [Class 2] [Class 6] [Class 48] [Class 96] <Insert Classification> according to NFPA 110.

E. Service Load: Generator system shall be sized to handle load scheduled on drawings on Generator Load Schedule, but shall not be less than <insert number> kW.

F. Power Factor: 0.8, lagging.

G. Frequency: 60 Hz.

H. Voltage: [208] [240] [480] [600] [4160] V ac.

I. Phase: Three-phase, [three] [four] wire, [wye] [delta].

J. Governor: Adjustable isochronous, with speed sensing.

K. Seismic Performance: Engine generator housing, engine generator, batteries, battery racks, silencers, [load banks,]and sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

L. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

M. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
   2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

N. Generator-Set Performance
   1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
   2. Transient Voltage Performance: Refer to Generator Sizing Schedule on drawings. Voltage shall recover and remain within the steady-state operating band within three seconds.
   3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
   4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   5. Transient Frequency Performance: Refer to Generator Sizing Schedule on drawings. Frequency shall recover and remain within the steady-state operating band within five seconds.
   6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
   8. Start Time: Refer to Generator Sizing Schedule on drawings. Comply with NFPA 110, Type 10, system requirements.

O. Generator-Set Performance for Sensitive Loads
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
   2. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
   3. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
   4. Transient Voltage: Refer to Generator Sizing Schedule on drawings. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
   5. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
   6. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   7. Transient Frequency Performance: Refer to Generator Sizing Schedule on drawings. Frequency shall recover and remain within the steady-state operating band within three seconds.

8. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
9. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
10. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
11. Start Time: Refer to Generator Sizing Schedule on drawings. Comply with NFPA 110, Type 10, system requirements.

P. Parallel Engine Generators:
1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

2.04 ENGINE

A. Fuel: [ASTM D975 #2 Diesel Fuel] [Natural gas] [LP gas] [Natural gas with automatic LP-gas standby] <Insert specific fuel grade requirements>.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Remote Cooling System: Closed loop, liquid cooled, with remote radiator and [integral engine-driven] [auxiliary] coolant pump. Comply with requirements in Section 232113 "Hydronic Piping" for coolant piping.
1. Configuration: [Vertical] [Horizontal] air discharge.
2. Radiator Core Tubes: [Aluminum] [Nonferrous-metal construction other than aluminum].
3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Fan: Driven by [multiple belts from engine shaft] [totally enclosed electric motor with sealed bearings].
6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

G. Muffler/Silencer
1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer’s engine backpressure requirements.
    a. Minimum sound attenuation of 25 dB at 500Hz.
    b. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 85 dBA or less.
2. Residential type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer’s engine backpressure requirements.
    a. Minimum sound attenuation 19 dB at 500 Hz.
    b. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge shall be 95 dBA or less.
3. Industrial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer’s engine backpressure requirements.
    a. Minimum sound attenuation 15 dB at 500 Hz.
    b. Sound level in the 20- to 75-Hz frequency band measured at a distance of 25 feet (8 m) from exhaust discharge shall be 87 dBA or less.

H. Air-Intake Filter: [Standard] [Heavy]-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: [12] [24]-V electric, with negative ground .
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: [As required by NFPA 110 for system level specified] [60 seconds].
4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article to provide specified cranking cycle at least [twice] [three times] without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

J. Installation of equipment required for emissions compliance shall include a complete manufacturer certified system, including, but not limited to any additional piping, heating and structural support.

2.05 FUEL SUPPLY SYSTEM

A. Diesel Fuel-Oil System
1. Comply with NFPA 37.
2. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
3. Fuel Filtering: Remove water and contaminants larger than 1 micron.
4. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
5. Day Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:

a. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
   1) Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
b. Tank Capacity: [As recommended by engine manufacturer for an uninterrupted period of 4 hours' operation at 100 percent of rated power output of engine generator system without being refilled] <Insert gallons (liters)>.
c. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
d. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
e. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
f. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
g. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

6. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with [UL 2085] [UL 142] fuel oil tank. Features include the following:
   a. Tank level indicator.
   b. Capacity: Fuel for [eight] <Insert number> hours' continuous operation at 100 percent rated power output.
   c. Leak detection in interstitial space.
   d. Vandal-resistant fill cap.
   e. Containment Provisions: Comply with requirements of authorities having jurisdiction.

B. [Natural Gas] [LP Gas] [Natural Gas with LP Gas Backup], Vapor-Withdrawal System:
1. Comply with NFPA 54 [and 58].
2. Carburetor.
3. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
4. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
5. Fuel Filters: One for each fuel type.
6. Manual Fuel Shutoff Valves: One for each fuel type.
7. Flexible Fuel Connectors: Minimum one for each fuel connection.
8. LP gas flow adjusting valve.
9. Fuel change gas pressure switch.

2.06 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate

automatic transfer switches initiate starting and stopping of the generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts the generator set. The off position of the same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

C. Configuration:
   1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.
   2. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine generator battery.
   3. Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:
      a. Wall-Mounted Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.
      b. Switchboard Construction: Freestanding unit complying with Division 26 Section "Switchboards."
      c. Switchgear Construction: Freestanding unit complying with Division 26 Section "Low-Voltage Switchgear."

D. Control and Monitoring Panel:
   1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
   2. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
   3. Instruments: Located on the control and monitoring panel and viewable during operation.
      a. Engine lubricating-oil pressure gage.
      b. DC voltmeter (alternator battery charging).
      c. Engine-coolant temperature gage.
      d. Running-time meter.
      e. AC voltmeter, [for each phase] [connected to a phase selector switch]
      f. AC ammeter, [for each phase] [connected to a phase selector switch]
      g. AC frequency meter.
      h. Generator-voltage adjusting rheostat.
   4. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
      a. Cranking control equipment.

b. Run-Off-Auto switch.
c. Control switch not in automatic position alarm.
d. Start-stop switch.
e. Overcrank alarm.
f. Overcrank shutdown device.
g. Low water temperature alarm.
h. High engine temperature prealarm.
i. High engine temperature.
j. High engine temperature shutdown device.
k. Low lub oil pressure alarm
l. Low lub oil pressure shutdown
m. Overspeed alarm.
n. Overspeed shutdown device.
o. Low fuel main tank.
    1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required [for the indicated EPSS class] [in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article].
p. Coolant low-level alarm.
q. Coolant low-level shutdown device.
r. EPS load indicator.
s. Battery high-voltage alarm.
t. Low cranking voltage alarm.
u. Battery-charger malfunction alarm.
v. Battery low-voltage alarm.
w. Contacts for local and remote common alarm.
x. Lamp test.
y. Coolant high-temperature prealarm.
z. Coolant high-temperature alarm.
aa. Coolant low-temperature alarm.
bb. Coolant high-temperature shutdown device.
cc. Hours of operation.
dd. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
ee. Remote manual stop shutdown device.
ff. Air shutdown damper alarm when used.
gg. Air shutdown damper shutdown device when used.
hh. Generator overcurrent protective device not closed alarm.
ii. Fuel tank derangement alarm.
jj. Fuel tank high-level shutdown of fuel supply alarm.

E. Connection to Power Monitoring and Control System: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

F. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

G. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
   1. Overcrank alarm.
   2. Coolant low-temperature alarm.
   3. High engine temperature prealarm.
   4. High engine temperature alarm.
   5. Low lube oil pressure alarm.
   6. Overspeed alarm.
   7. Low fuel main tank alarm.
   8. Low coolant level alarm.
   9. Low cranking voltage alarm.
   10. Contacts for local and remote common alarm.
   11. Audible-alarm silencing switch.
   12. Air shutdown damper when used.
   13. Run-Off-Auto switch.
   14. Control switch not in automatic position alarm.
   15. Low cranking voltage alarm.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.07 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

B. Generator Overcurrent Protective Device:
   1. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying UL 489.
      a. Tripping Characteristic: Designed specifically for generator protection.
      b. Trip Rating: Matched to generator rating.
      c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
      d. Mounting: Adjacent to or integrated with control and monitoring panel.
   2. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
      a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
      b. Trip Settings: Matched to generator thermal damage curve as closely as possible.
      c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

d. Mounting: Adjacent to or integrated with control and monitoring panel.

3. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
   a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   b. Trip Settings: Matched to generator thermal damage curve as closely as possible.
   c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
   d. Mounting: Adjacent to or integrated with control and monitoring panel.
4. Generator Disconnect Switch: Molded-case type, 100 percent rated.
   a. Rating: Matched to generator output rating.
   b. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
1. Indicate ground fault with other engine generator alarm indications.
2. Trip generator protective device on ground fault.

2.08 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1 and specified performance requirements.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.09 LOAD BANK

A. Description:
   1. Permanent, outdoor, weatherproof, remote-controlled, forced-air-cooled, [resistive] [resistive and reactive] unit capable of providing a balanced 3-phase, delta-connected load to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. [Unit may be composed of separate resistive and reactive load banks controlled by a common control panel.] Unit shall be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.
   2. Permanent, radiator-mounted[, resistive] unit capable of providing a balanced three-phase, delta-connected load to engine generator at 70 percent rated-system capacity. Unit shall be capable of selective control of load in 25 percent steps of load-bank rating and with minimum step changes of approximately 5 and 10 percent available.

B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.

C. Reactive Load Elements: Epoxy-encapsulated reactor coils.

D. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of the specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of the resistance elements.

E. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.

F. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.

G. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- (13-mm-) square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge.

H. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.

I. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.

J. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.10 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description:
1. Vandal-resistant, sound-attenuating, weatherproof steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
   a. Sound Attenuation Level: [Level I][Level II]
2. Prefabricated or preengineered, galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure erected on concrete foundation.

B. Construction:
1. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).
2. Seismic Design: Comply with seismic requirements in Division 26 "Seismic Controls for Electrical Systems."
3. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
4. Hinged Doors: With padlocking provisions.
5. Space Heater: Thermostatically controlled and sized to prevent condensation.
6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.

C. Muffler Location: [Within enclosure] [External to enclosure].

D. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
   a. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

E. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

F. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.11 REMOTE RADIATOR MOTORS

A. Description: NEMA MG 1, Design B, medium-induction, random-wound, squirrel-cage motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

E. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

F. Temperature Rise: Match insulation rating.

G. Code Letter Designation:
1. Motors [15] <Insert number> HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than [15] <Insert number> HP: Manufacturer's standard starting characteristic.

H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.12 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
2. Fiberglass or cork isolator pads: molded cork or glass fiber not less than 1 inch thick and pre-compressed through 10 compression cycles at 3 times the rated load.
3. Load range: from 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
   2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

D. Comply with requirements in Div. 23 “Vibration Isolation for HVAC” " for vibration isolation and flexible connector materials for steel piping, exhaust shroud and ductwork..

2.13 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.14 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests:
      a. Comply with IEEE 115.
      b. Comply with NFPA 110, Level 1 energy converters.
   2. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype shall have been factory tested to demonstrate compatibility and reliability.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Test generator, exciter, and voltage regulator as a unit.
   3. Full load run.
   4. Maximum power.
   5. Voltage regulation.
   6. Transient and steady-state governing.
   7. Single-step load pickup.

8. Safety shutdown.
9. Observation of Factory Tests: Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

C. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
   1. For installations where field-deployed after treatment equipment is utilized, install equipment in accordance with manufacturer’s requirements to ensure the final installation meets the manufacturer’s definition of a factory-certified arrangement.

B. Equipment Mounting:
   1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
   2. Coordinate size and location of concrete bases for packaged engine generators[and remote radiators mounted on grade]. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
   3. Install packaged engine generator with [elastomeric isolator pads] [restrained spring isolators] having a minimum deflection of [1 inch (25 mm)] <Insert static deflection> on 4-inch- (100-mm-) high concrete base. Secure to anchor bolts installed in concrete base.
   4. Remote Radiators:
      a. Install remote radiator with [elastomeric isolator pads] [restrained spring isolators] on [concrete base on grade] [roof equipment supports on roof].
      b. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. Refer to Div. 23 for these accessories.

C. Install cooling-system piping, accessories, hangers and supports, and anchors for complete installation.
   1. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
   2. Install the following pipe attachments:

a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
c. Spring hangers to support vertical runs.

3. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   a. NPS 1 (DN 25) and Smaller: Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
   b. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
   c. NPS 2 (DN 50) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
4. Support cooling-system piping with pipe hangers spaced horizontally and at each floor vertically. Pipe hangers are specified in Division 23 Section "Hangers and Supports."
5. Restrain cooling-system piping with cable-type bracing assemblies. Cable-type bracing assemblies are specified in Division 26 Section "Electrical Supports and Seismic Restraints."
6. Extend drain piping from heat exchangers to point of disposition.

D. Install exhaust-system piping [and after treatment system]. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.
1. Install condensate drain piping for engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.
2. Support exhaust piping[, after treatment system] and muffler with pipe hangers spaced a maximum of 20 feet (6 m) horizontally and at each floor vertically. Pipe hangers are specified in Division 23 Section "Hangers and Supports."
3. Restrain exhaust piping and mufflers with cable-type bracing assemblies. Cable-type bracing assemblies are specified in Division 26 Section "Electrical Supports and Seismic Restraints."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
1. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
2. Connect cooling-system water supply and drain piping to [gas] [diesel]-engine heat exchangers. Install flexible connectors at connections to engine generator and remote radiator.
3. Connect fuel piping to engines with a gate valve and union.
   a. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems outside the building are specified in Division 02 Section "Fuel Oil Distribution."
   b. Diesel fuel piping, valves, and specialties inside the building are specified in Division 23 Section "Fuel Oil Piping."

c. Natural- and LP-gas piping, valves, and specialties for gas distribution outside the building are specified in Division 02 Section "Natural Gas Distribution."
d. Natural- and LP-gas piping, valves, and specialties for gas piping inside the building are specified in Division 23 Section "Fuel Gas Piping."

4. Connect exhaust-system piping to engines.

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 ."

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.05 FIELD QUALITY CONTROL

A. Testing Agency:
1. Owner will engage a qualified testing agency to perform tests and inspections.
2. Engage a qualified testing agency to perform tests and inspections.
3. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
4. Perform tests and inspections[with the assistance of a factory-authorized service representative].

B. Tests and Inspections:
1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
a. Visual and Mechanical Inspection:
1) Compare equipment nameplate data with Drawings and the Specifications.
2) Inspect physical and mechanical condition.
3) Inspect anchorage, alignment, and grounding.
4) Verify that the unit is clean.
b. Electrical and Mechanical Tests:
1) Perform insulation-resistance tests according to IEEE 43.
a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
2) Test protective relay devices.

3) Verify phase rotation, phasing, and synchronized operation as required by the application.
4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
5) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at [four] <Insert number> locations [on the property line] <Insert location for measurement>, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and [retest] [reinspect] as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

C. Complete installation and startup checks according to manufacturer's written instructions.

D. Provide sufficient fuel for testing, commissioning and start up, and turn the generator over to the owner with a full tank upon the Owner’s acceptance of the completed generator and standby/emergency power distribution systems.

E. For installations that utilize a Diesel Exhaust Fluid (DEF) or other type of urea dosing system as part of the field-deployed after-treatment, Provide sufficient DEF for testing, commissioning and start up, and turn the generator over to the owner with a full tank upon the Owner’s acceptance of the completed generator and standby/emergency power distribution systems.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
   1. Coordinate this training with that for transfer switches..

END OF SECTION 263213

SECTION 263215
GENERATOR TERMINATION CABINETS

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This section specifies the furnishing, installation, and connection of a low-voltage temporary generator quick connection panel, indicated as “Termination Cabinet” in this section.

B. Generator Quick Connection Termination Cabinet shall allow quick and safe connection of a mobile generator set to facilities experiencing loss of power.

1.02 QUALITY ASSURANCE

A. Perform factory and installation tests in accordance with applicable NEC requirements.

B. Tap Box shall conform to the dielectric (HI POT) test from UL891.

1.03 REFERENCE STANDARDS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) were referenced to form parts of this specification.

B. National Electrical Manufacturer's Association (NEMA):

C. NEMA PB-2.1-07 - Proper Handling, Installation, Operation, and Maintenance of Dead-front Distribution Switchboards Rated 600 Volts or Less

D. National Fire Protection Association (NFPA):
1. 70-11 National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
1. 50 Standard for Enclosures for Electrical Equipment
2. 891 Switchboards
3. 1008 Supplement SB Standard Requirements for Inlet Assemblies for Transfer Switch Equipment

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data.

B. Drawings: Submit shop drawings for approval. Include components, materials, finishes, detailed plan and elevation views, cam type openings, and accessories.

1.05 INTERRUPTION OF EXISTING ELECTRICAL DISTRIBUTION SYSTEMS:

A. Refer to Division 26 Section “General Electrical Requirements” for procedures regarding interruption of electrical systems

1.06 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Size and electrical characteristics shall be as noted on the Drawings.

B. Termination Cabinet shall have the following features:
1. Termination Cabinet shall be a complete, grounded, continuous-duty, integral assembly, dead-front, wall mountable, outdoor type Termination Cabinet assembly. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
2. Termination Cabinet shall be supplied as a complete system and shall include all the necessary components and equipment to accommodate described system operation unless otherwise noted.
3. Termination Cabinet shall conform to the arrangements and details shown on the drawings.
4. Termination Cabinet shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site.
5. All non-current-carrying metallic parts shall be grounded.

2.02 MANUFACTURER:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Power Technologies (APT)
2. Square D
3. Eaton
4. Siemens
5. GE

2.03 HOUSING

A. Enclosure:
1. Enclosure shall be a wall-mount outdoor NEMA 3R manufactured from Carbon Steel.
2. The enclosure shall include a full front pad lockable door to access permanent cables and a hinged integral lower flip open door to allow cable connection of the temporary generator.
3. The lower flip door shall be mechanically interlocked with the main front door for personnel protection when the connection panel is not in use.
4. The mechanical interlock shall only allow the flip door to open if the front door is already open.
5. Temporary generator cables shall only be able to be connected through the lower flip door.
6. Stainless Steel exterior hardware shall be utilized.

7. For ease of the Termination Cabinet service, maintenance and future upgrades, all the support structures, braces and cover sheets for the circuit breakers, main bus, neutral bus, and ground bus shall be removable and attached via bolts.

B. Finish:
1. One (1) powder coat of ANSI 61 Light Gray shall be applied to all interior and exterior surfaces.
2. The final finish must be exterior rated for NEMA 3R use.

2.04 BUSSING

A. Silver plated copper busbar shall be used for “permanent” cable connections to the facility via the side or rear sheets of enclosure.

2.05 LUGS

A. Permanent facility side (Load) connections shall connect to busbar via mechanical lugs.

B. Provide additional mechanical lugs for temporary connections when Cam-Lok style connectors are not available.

2.06 ‘CAM-LOK’ TYPE CONNECTORS

A. ‘Cam-Lok’ type connectors shall be NEMA 3R rated to be used in direct rain should the door become open.

B. Each color-coded, male ‘Cam-Lok’ compatible single pole receptacle with cover shall be color coded as follows:

PHASE	120/240V	240Δ/120V	208Y/120V	480Y/277V
A	Black	Black	Black	Brown
B	Red	Orange	Red	Orange
C	N/A	Red	Blue	Yellow
Neutral	White	White	White	Gray**
Equipment Ground	Green	Green	Green	Green
Isolated Ground	N/A	N/A	Green/Yellow Stripe	N/A

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Termination Cabinet in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Floor/ground mounted termination cabinets shall be mounted on a housekeeping pad.

C. Securely anchor termination cabinets to the wall.

D. Clear, detailed, written instructions are to be permanently attached to the quick connect and electrical gear being served by it for staff reference.

E. A laminated, color-coded, large-format one-line diagram shall be provided in the associated electrical room.

3.02 IDENTIFICATION

A. Label products as specified in Division 26 Section "Identification for Electrical Systems".

B. Equipment Nameplates: Label each cabinet with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   1. Each Termination Cabinet shall have a label permanently affixed to it, listing the following information: Name of manufacturer, system voltage, ampacity, and type.
   2. Each phase indicating nameplate shall be black lettering on the appropriate phase color background.
   3. A nameplate shall identify each component mounted inside the panel.

C. Field-installed wiring and components: Identify as specified in Division 26 Sections “Low Voltage Electrical Power Conductors and Cables” and "Identification for Electrical Systems."

D. Operating Instructions: Provide Instruction Signs complying with requirements for identification specified in Division 26 "Identification for Electrical Systems." Include instruction for key interlocking, control sequences, elementary single-line diagram, and emergency procedures. Mount on front of cabinet.

3.03 TRAINING

A. Allow 4 hours of training for the Owner’s facility personnel. Instruction shall include the use, maintenance and safety requirements for the equipment.

END OF SECTION 263215

SECTION 263600
TRANSFER SWITCHES

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches.
   2. Bypass/isolation switches.
   3. Nonautomatic transfer switches.
   4. Remote annunciation systems.
   5. Remote annunciation and control systems.

B. This section does not include the following:
   1. Double throw (manual type) switches. Refer to Division 26 section “Enclosed Switches and Circuit Breakers” for this equipment.
   2. Medium Voltage Automatic Transfer Switches. Refer to Section(s) 261300 or section 262313 for this equipment.

1.02 DEFINITIONS

A. Closed Transition (Make–Before–Break): In a switching device, a configuration in which the new connection path is established before the previous contacts are opened. This prevents the switched path from ever seeing an open circuit.

B. Open Transition (Break-Before-Make): A switch that is configured to break (open) the first set of contacts before engaging (closing) the new contacts. This prevents the momentary connection of the old and new circuit paths together.

C. Withstand duration: The withstand rating value is the level of fault current that must be withstood for a specified length of time, i.e., 42000 amps at 3 cycles.

D. Level 1 Equipment: Level 1 is the more stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system, including the transfer equipment could result in loss of human life or serious injury.

E. Level 2 Equipment: Level 2 is the less stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system including the transfer equipment is less critical to human life safety.

F. NETA ATS: InterNational Electrical Testing Association Acceptance Testing Specification.

1.03 ADMINISTRATIVE REQUIREMENTS

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. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section “Overcurrent Protective Device Coordination Study”

1.04 SUBMITTALS

A. Product Data: For each type of transfer switch, switching and overcurrent protective device, instrumentation, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each transfer switch and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances, service space around equipment, and attachments to other work. Show tabulations of installed devices, equipment features, and ratings.
   a. Tabulate features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Detail enclosure types and details for other than NEMA 250, Type 1.
3. Include general arrangement drawing showing dimensions and weights of each assembled section.
4. Detail bus configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus. Indicate mains and branches of phase, neutral, and ground buses. Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
5. Detail short-circuit current rating of transfer switch assembly and overcurrent protective devices.
6. Include descriptive documentation of barriers specified for electrical insulation and isolation.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include evidence of NRTL listing for series rating of installed devices.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in transfer switch; include selectable ranges for each type of overcurrent protective device. Submit electronic files, in an SKM-compatible format.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.
12. Include nameplate legends.
13. Include list of materials.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around transfer switches where pipe and ducts are prohibited. Show

transfer switch layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

1. For each equipment room, provide dimensioned layout of the electrical equipment within the space, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
2. Dimensioned concrete base, outline of transfer switch, conduit entries, and ground rod locations; including equipment working clearances and manufacturer required access space.
3. Indicate structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
4. Location of structural supports for structure-supported raceways[, busways,] [and seismic bracing].
5. Location and clearance of electrical equipment and raceways impacting equipment installation.
6. Proposed routing of equipment, in shipping splits, from exterior of the building to the final installed location. Include product weights, width and height restrictions encountered along the path. Include intended construction sequencing to mitigate conflicts.
7. Proposed routing of equipment for future removal, from within equipment room to exterior of the building without removal of non-related equipment or architectural elements.

D. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.

E. Seismic Qualification Data: For panelboard equipment, accessories, and components, from manufacturer.
1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Qualification Data: For qualified manufacturer and testing agency.

G. Factory test reports.

H. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.

I. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

J. Manufacturer's field service report.

K. Sample Warranty: For warranties.

L. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

M. Project Record Documents: Record actual installed equipment and circuiting arrangements. Record actual routing for underground circuits. Record actual installed location of ground rods.

N. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for panelboards and all installed components.
   2. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   3. Time-current curves; include selectable ranges for each type of overcurrent protective device. Provide relay-settings and calibration instructions, including software, where applicable.
   4. Features and operating sequences, both automatic and manual.
   5. Video recording of operation training and demonstration.

O. Follow-up service reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain [automatic transfer switches] [bypass/isolation switches] [non-automatic transfer switches] [remote annunciators] [and] [remote annunciator and control panels] through one source from a single manufacturer. [The manufacturer furnishing the generator shall be the same supplier of the transfer switch. The transfer switch circuit breaker (if present) shall be coordinated with the generator circuit breaker to provide coordinated tripping.]

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NEMA ICS 1.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with NFPA 110.

J. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.06 PROJECT CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Environmental Limitations:
   1. Do not deliver or install transfer switches until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above equipment 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 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
      b. Altitude: Not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to occupied facilities. Refer to Division 26 Section “General Electrical Requirements” for allowable outages.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving equipment into place.

B. Deliver transfer switches in sections or lengths that can be moved past obstructions in delivery path.

C. Coordinate delivery of equipment to allow movement into designated space.

D. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish. Provide temporary heating according to manufacturer's written instructions.

E. Handle and prepare transfer switch components according to manufacturer's written instructions. Use factory-installed lifting provisions.

1.08 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of the Transfer Switch that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Damage from transient voltage surges.
      b. <Insert type of failure>.

B. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

C. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.09 SEISMIC REQUIREMENTS

A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section “Seismic Controls for Electrical Systems” and Division 20 Section “Seismic Controls for MEP/F/T Systems”.

1.10 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. Indicating Lights: Four of each type installed.
   2. Switching Contact Lubricant: One container.
   3. Alarm Contacts: Equal to 10 percent of quantity supplied, but no fewer than two of each type.
   4. Touchup Paint: Two containers of paint matching enclosure finish, each 0.5 pint (250 mL).
   5. Enclosure Keys: Two for each enclosure type. All distribution equipment keyed alike.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. [Available] Manufacturers:
   1. Contactor Transfer Switches:
      a. Caterpillar; Engine Div.
      b. Eaton Electrical Inc.; Cutler-Hammer
      c. Emerson; ASCO Power Technologies, LP.
      d. GE Zenith Controls.
      e. Rehlko (Formerly Kohler Power Systems).
      f. Onan/Cummins Power Generation; Industrial Business Group.
      g. Russelectric, Inc.
      h. Spectrum Detroit Diesel.
      i. <Insert manufacturer's name.>
   2. [Transfer Switches Using Molded-Case Switches or Circuit Breakers:
      a. Eaton Electrical Inc.; Cutler-Hammer.
      b. GE Zenith Controls.
      c. Hubbell Industrial Controls, Inc.
      d. <Insert manufacturer's name.>

B. Indicated Voltage and Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated. Voltage ratings shall be consistent with applications

from 115 volts AC to 600 volts and single or three phase as required by the application. Current ratings and the number of poles shall be as indicated on the plans.

C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
   2. Where the transfer switch internal fault-current protection can not exceed the indicated fault-current values, an enclosed fused switch with current limiting fuses shall be installed ahead of the transfer switch.

D. Controls: [Solid State] [Microprocessor] control having repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C. All internal controls components shall be accessible from the equipment front.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. [Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.]
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. [Neutral Switching: Where four-pole switches are indicated, provide [neutral pole switched simultaneously with phase poles.] [overlapping neutral contacts]]. [The neutral switch shall be located on the common shaft with the phase poles.]

I. [Neutral Terminal: Solid and fully rated bus bar, unless otherwise indicated.]

J. [Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.] [If not so rated then the minimum neutral rating shall be equal to the continuous ampacity rating of the phase poles.]

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. [Battery Charger: For generator starting batteries.
   1. Float type rated [2] [10] A.
   2. Ammeter to display charging current.
   3. Fused ac inputs and dc outputs.]

M. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. All factory wiring shall be accessible from the equipment front. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated. Power terminals shall be rated for 90 degree C and copper or aluminum cable.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

O. Enclosures: General-purpose NEMA 250, Type [1] [3R] [12], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

P. Bus and Wiring: All Bus and cable /control wire shall be copper.

Q. Cable Entry: Cable entry shall be from the [top.] [bottom.] [top and bottom.]

R. [Service Entrance Rating: Where indicated on the plans, the Automatic transfer switch shall be UL rated for use as service entrance equipment.]

2.02 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. [Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.]

H. [Automatic open-transition transfer switches: Include the following functions and characteristics:
1. Fully automatic break-before-make.]

I. [Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
   a. Initiation occurs without active control of generator.
   b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
4. Failure of power source serving load initiates automatic break-before-make transfer.]

J. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

K. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

L. [Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.] [The neutral shall not be stopped at mid point for any reason and shall transfer unimpeded from one position to the other.]

M. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Frequency: Monitor the frequency of the incoming normal power circuit. For the normal source, initiate transfer if the frequency varies more that 5% from the rated nominal value. For the emergency source, inhibit transfer if the normal source circuit frequency varies more that 5% from the rated nominal value.
4. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

5. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
6. Test Switch: Simulate normal-source failure.
7. Switch-Position Pilot Lights: Indicate source to which load is connected.
8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
11. [Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.] [Time Delay, adjustable from 0 to 6 seconds, is included.] [Engine starting contact shall remotely start the generator immediately upon initiation by the normal source monitor.]
12. [Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.]
13. [Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.]
14. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.
15. [Elevator Application: Provide the following functions if automatic transfer is for elevator control:
    a. Auxiliary contact closure upon the transfer to the alternate source to signal the elevator controller(s) for emergency operation.
    b. Auxiliary contact closure, adjustable from 0 to 20 seconds before retransfer to normal source to allow for elevator motor-generator sets to disconnect from the power source.
    c. Auxiliary contact closure, adjustable from 0 to 20 seconds before testing transfer operation to signal the elevator controller(s) for emergency operation.]

2.03 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Bypass/Isolation switch shall have main contacts and operating mechanism similar to the Automatic Transfer Switch except all operations shall be manual. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
   1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
   2. [Drawout Arrangement for Transfer Switch: The isolating portion of the isolation/bypass switch shall provide physical separation from all live parts (power and control) to provide accessibility for testing and maintenance operations of the transfer switch.]
   3. Bypass/Isolation Switch Configuration, Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
   4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
   5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less. Operation of the bypass/isolation switch shall be allowed regardless of the position of the automatic transfer switch. Switch operation shall provide for positive and complete sequencing of all contact motion and shall prevent any form of intermediate stop or delayed motion.
   6. Engine Run Circuit Interface: There shall be sufficient controls included to assure that the engine run circuit remains closed when the switch is in the bypass-to-emergency position even though the associated transfer switch is in the normal position or completely removed from the enclosure.
   7. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
   8. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors. If the unit is constructed such that removal of components is not allowed, then the Automatic Transfer Switch section shall be isolated from the Bypass Isolation Switch section by means of insulated barriers.
   9. The bypass isolation switch shall be provided with indicating lights identifying location in bypass position, full isolation position, and source availability.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current. [Interconnection shall be by way of copper cables installed in suitable raceway for the application.]

D. The bypass isolation switch maybe located in the same enclosure as the automatic transfer switch or maybe located separately in a dedicated enclosure adjacent to the automatic transfer switch enclosure.

E. The bypass/isolation switch shall maintain a mechanical separation of the normal and emergency power sources to guard against the inadvertent connection of unsynchronized sources together. Electrical interlocking alone will not be considered acceptable.

2.04 NONAUTOMATIC TRANSFER SWITCHES

A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Nonautomatic Transfer-Switch Accessories:
   1. Pilot Lights: Indicate source to which load is connected.
   2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
   3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.05 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
   1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
   2. Switch position.
   3. Switch in test mode.
   4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
   1. Indicating Lights: Grouped for each transfer switch monitored.
   2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
   3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
   4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.06 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:
   1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
   2. Indication of switch position.
   3. Indication of switch in test mode.

4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.07 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

2.08 IDENTIFICATION

A. Nameplates: Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

B. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.
1. Mimic-bus segments coordinated with devices in transfer switches to which applied, to produce a concise visual presentation of principal switchboard components and connections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine transfer switches before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.

B. Examine areas, surfaces, substrates, and elements to receive transfer switches with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that field measurements are as indicated.
2. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

C. Examine roughing-in of conduits and grounding systems to verify the following:
1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install transfer switches and accessories in accordance with manufacturer’s instructions.

B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems."

D. Wall-Mounted Switch: Install transfer switches on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For transfer switches not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

E. Floor-Mounted Switch: Install transfer switches on concrete bases.
1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of transfer switches unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
2. Anchor transfer switches to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Sections "Hangers and Supports for Electrical Systems" and "Seismic Controls for Electrical Systems."
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to transfer switches.

F. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from enclosure and components.

H. Mount equipment plumb and rigid without distortion of enclosure.

I. Arrange conductors in auxiliary compartments and gutters into groups and bundle and wrap with wire ties.

J. Comply with NECA 1.

3.03 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

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."

D. 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 for control wiring.

3.04 IDENTIFICATION

A. Equipment Nameplates: Label each contiguous main, or entrance, section with equipment nameplate.

B. Device Nameplates: Label each main and bypass device with a nameplate.

C. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

D. Diagram and Instructions:
   1. Engraved, Laminated Acrylic or Melamine Label. Mount on front of transfer switch.
      a. Operating Instructions: Printed operating instructions for transfer switch, including key interlocking, control sequences, elementary single-line diagram, and emergency procedures.
      b. System Power One-Line Diagrams: Provide color-coded, large-format one-line diagram showing the new work is to be provided and installed in the associated electrical room. Depict power sources, feeders, distribution components, and major loads.
   2. Storage for Maintenance Instructions: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

E. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.

3.05 CLEANING

A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.07 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.08 FIELD QUALITY CONTROL

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

B. Testing: Engage a qualified testing agency to perform the following field quality-control tests and inspections:

C. Testing: Perform the following field quality-control tests and inspections:
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, to assist in testing, and to assist in adjusting device settings.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

E. Coordinate tests with tests of generator and run them concurrently.

F. Acceptance Testing Preparation:
   1. After installing equipment but before equipment is energized, test for compliance with requirements.
   2. Test insulation resistance for each bus, component, connecting supply, feeder, and control circuit.
   3. Test continuity of each circuit.

G. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. After electrical circuitry has been energized, test for compliance with requirements.
   2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    a. Verify grounding connections and locations and ratings of sensors.
    b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
7. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

H. Assist in field commissioning of equipment including pretesting and adjusting of equipment and components.

I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. 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.

J. Transfer switches will be considered defective if they do not pass tests and inspections.

K. Prepare test and inspection reports, including a certified report that identifies transfer switches included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment, instrumentation, and accessories, and to use and reprogram microprocessor-based control, monitoring, and display functions.

B. Video record demonstrations presentation for Owner’s records.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313
SURGE PROTECTION DEVICES

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

A. This section includes field or factory-mounted Surge Protective Devices (SPDs) for low-voltage (120 to 600 V) power distribution and control equipment, including:
   1. Surge Protection Devices at Service Entrance Equipment
   2. Surge Protection Devices at Distribution Equipment
   3. Surge Protection Devices at Branch Panelboards
   4. Surge Protection Devices at Utilization Equipment
   5. Surge Protection Devices in Electronics-Grade Panelboards

1.02 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. I*n* or I*nominal*: Nominal Discharge Current. Peak value of surge current, selected by the manufacturer, through the SPD having current wave shape of 8/20 microseconds where the SPD remains functional after 15 surges. I*n* is posted on the device UL label.

C. MCOV: Maximum Continuous Operating Voltage. The maximum continuous operating voltage rating of a Metal Oxide Varistor (MOV) that can be applied without the MOV being damaged and/or destroyed by thermal runaway. MCOV is posted on the device UL label.

D. SCCR: Short Circuit Current Rating. The maximum current rating the SPD can sustain without being damaged and/or destroyed. SCCR is posted on the device UL label.

E. SPD: Surge Protective Device. A broad class of protective devices, installed parallel with the distribution panel or service disconnect, meant to protect downstream electrical distribution equipment from the effects of high voltage surges on the line.

F. SPD Type definitions:
   1. TYPE 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 1 devices are required for Master Certification of Lightning Protection System installations under UL 96A.
   2. TYPE 2: Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch circuit panel.
   3. TYPE 3: Point-of-utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, e.g., cord-connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (10 meters or 30 feet) is exclusive of conductors provided with or used to attach SPD's.
   4. TYPE 4: Component SPDs, including discrete components as well as component assemblies for installation on panelboards or control panels.

G. VPR: Voltage Protection Rating. The average of measured limiting voltage before and after Nominal Discharge Testing (In), rounded up to one of UL's VPR categories (indicated in the latest ANSI/UL 1449 edition) such as 330 volt, 400 volt, 500 volt, etc. VPR is posted on each device UL label.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate SPD devices with Division 26 Section "Electrical Power Monitoring and Control."

B. Coordinate layout and installation of SPDs 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.

C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Overcurrent Protective Device Coordination Study".

D. Do not energize or connect any electrical or low voltage equipment to their sources until SPDs are installed and connected.

E. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is over.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".

B. Product Data: For each SPD type, accessory, component and enclosure indicated. Include dimensions and Manufacturer's technical data on features, performance, electrical characteristics, ratings, weights, furnished options, specialties, accessories, and finishes. Tabulate model number, SPD type, system voltage, phases, modes of protection, MCOV, VPR, and I_n.

C. Shop Drawings: For SPDs.
1. Detail enclosure types and details.
2. Include general arrangement drawing showing dimensions and weights of each assembled device.
3. Include installation and mounting details for SPDs internal to equipment.
4. Detail bus connection configuration, current, and voltage ratings, including size and number of bus bars and current rating for each bus.
5. Detail short-circuit current rating of SPD assembly and overcurrent protective devices.
6. Include schematic and wiring diagrams for power, signal, and control wiring.
7. Include insertion loss bode plots.
8. Include nameplate legends.
9. Include list of materials.

D. Product Certificates: For SPDs, from manufacturer.

E. Sustainable Design Documentation: Submit manufacturer's product data on materials and assemblies showing compliance with building rating standard(s) requirements.

F. Qualification Data: For qualified testing agency.

G. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

H. Manufacturer's field service report.

I. Sample Warranty: For warranty.

J. Project Record Documents: Record actual installed equipment and circuiting arrangements.

K. Operation and Maintenance Data: For SPDs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for SPDs and all installed components.
   2. Manufacturer's written instructions for testing and adjusting SPDs.
   3. Time-current curves for each type of overcurrent protective device.
   4. Features and operating sequences, both automatic and manual.
   5. Video recording of operation training and demonstration.

L. Follow-up service reports.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

C. Source Limitations: Obtain SPDs of each type and associated components and accessories through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

E. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

F. Comply with NEMA LS 1.

G. Comply with UL 1283 and ANSI/ UL 1449.

H. Comply with NFPA 70.

I. The SPDs shall be compliant with the restrictions of the Hazardous Substances (RoHS) Directive 2002/95/EC.

1.06 PROJECT CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Environmental Limitations:
   1. Do not install SPDs until spaces are enclosed and weathertight. Equipment shall be protected from any remaining wet work in the space and work above equipment. Provide temporary HVAC system for 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 less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
      b. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
      c. Humidity: 0 to 85 percent, noncondensing.
      d. Altitude: Less than 20,000 feet (6090 m) above sea level.

C. Interruption of Existing Electrical Service: Refer to Division 26, Section “General Electrical Requirements”.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space, protected from weather and so condensation will not form on or in units. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic. Handle carefully in accordance with manufacturer's instructions to avoid damage to equipment components, enclosure, and finish.

B. Handle and prepare SPD components according to manufacturer's written instructions.

1.08 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.09 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Replaceable Protection Modules: One of each size and type installed.

PART 2 PRODUCTS AND MATERIALS

2.01 GENERAL

A. Manufacturers:
1. ABB USA.
2. Eaton.
3. Intermatic, Inc.
4. LEA International.
5. Leviton Mfg. Company Inc.
6. Siemens.
7. Schneider Electric.
8. Surge Suppression Incorporated.
9. Vertiv.

B. Surge Protective Device Ratings: Device type ratings shall be:
1. Type 1 - Service entrances
2. Type 2 - Service entrance equipment or distribution equipment
3. Type 3 - Utilization equipment or point of use.

C. Nominal System Voltage: Match the system voltage to which the SPD is connected, as indicated on the drawings.

D. Maximum Continuous Operating Voltage: Not less than 125 percent of nominal system voltage for 240V or less power systems, and not less than 115 percent of nominal system voltage for 600V and 480V power systems.

E. Comply with ANSI/UL 1449.

F. SPDs for Lightning Protection: For Lightning Protection Systems specified or otherwise required to be “Master Labeled” per UL 96A utilize Type 1 (20kA rated I_n) SPDs.

G. SPDs for PV systems: For Photovoltaic Systems specified, SPDs shall be either DC rated or Dual Rated for AC and DC.

2.02 SURGE PROTECTION DEVICES AT SERVICE ENTRANCE EQUIPMENT

A. Surge Protection Devices: [Externally][Integrally] mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits; with individually fused metal-oxide varistors,
5. Redundant replaceable modules.
6. EMI filtering: Minimum 45dB at 100kHz for L-N Modes.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.

10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Six-digit transient-event counter set to totalize transient surges.

B. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 20kA per mode.
2. Type 2 SPD's shall be tested and labeled at 20kA per mode.

C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 200 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

D. Protection Modes:
1. Protection mode VPR for grounded wye circuits 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 240/120 V circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1400 from high leg
Line to Ground	1000	1000, 1400 from high leg
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		2000	2500

2.03 SURGE PROTECTION DEVICES AT DISTRIBUTION EQUIPMENT

A. Surge Protection Devices: [Externally][Integrally] mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits; with individually fused metal-oxide varistors,
5. Redundant replaceable modules.
6. EMI filtering: Minimum 45dB at 100kHz for L-N Modes.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Six-digit transient-event counter set to totalize transient surges.

B. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 20kA per mode.
2. Type 2 SPD's shall be tested and labeled at 20kA per mode.

C. 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.

D. Protection Modes:
1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

2.04 SURGE PROTECTION DEVICES AT BRANCH PANELBOARDS

A. Surge Protection Device: [Externally][Integrally] mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits; with individually fused metal-oxide varistors,
5. Redundant replaceable modules.

6. EMI filtering: Minimum 45dB at 100kHz for L-N Modes.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Six-digit, transient-event counter set to totalize transient surges.

B. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 2 SPD's shall be tested and labeled at 20kA per mode.

C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

D. Protection Modes:
1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

2.05 SURGE PROTECTION DEVICES AT UTILIZATION EQUIPMENT

A. Surge Protection Device: Externally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses, rated at 100-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.

3. Integral disconnect switch.
4. Redundant suppression circuits; with individually fused metal-oxide varistors,
5. Redundant replaceable modules.
6. EMI filtering: Minimum 45dB at 100kHz for L-N Modes.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Six-digit, transient-event counter set to totalize transient surges.

B. Nominal Discharge current (I_n): For outdoor SPDs, the SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 3 SPD's shall be tested and labeled at 10kA per mode.

C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 80 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

D. Protection Modes:
1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

2.06 SURGE PROTECTION DEVICES IN ELECTRONICS-GRADE PANELBOARDS

A. Surge Protection Device: Integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules short-circuit current rating matching or exceeding the available short-circuit indicated on the plans, and with the following features and accessories:
1. Fuses rated at 200-kA interrupting capacity.

2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits; with individually fused metal-oxide varistors,
5. Redundant replaceable modules.
6. EMI filtering: Minimum 45dB at 100kHz for L-N Modes.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Six-digit, transient-event counter set to totalize transient surges.

B. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 2 SPD's shall be tested and labeled at 20kA per mode.

C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.

D. Protection Modes:
1. Protection mode VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2. Protection mode VPR for 1-phase, 3-wire circuits shall be as follows:

	240/120V, 1ph, 3w	240/120V, 3ph, 4w (high leg)
Line to Neutral	700	700, 1500 from high leg
Line to Ground	1000	1000
Neutral to Ground	700	700

3. Protection mode VPR for 3-phase, 3-wire, delta circuits shall be as follows:

	240V	240V (Delta)	480V	600V
Line to Line	1000	1500	2000	2500
Line to Ground	800		1500	2500

2.07 ENCLOSURES

A. All SPD Units shall be fully enclosed unless otherwise noted. Provide enclosures suitable for the locations indicated and as described below:
1. Indoor Enclosures:
a. NEMA 250 Type 1 constructed of a polymer or steel material

b. NEMA 250 Type 12 constructed of a polymer or steel material with a gasket to exclude dust.

2. Outdoor Enclosures:
   a. NEMA 250 Type 3R constructed of steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, and snow) from entering the enclosure when shut.
   b. NEMA 250 Type 4 constructed of steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, snow, splashing water or hose directed water) from entering the enclosure when shut.
   c. NEMA 250 Type 4X constructed of stainless steel material and with a gasket to exclude dirt, windblown dust, and water (rain, sleet, snow, splashing water or hose directed water) from entering the enclosure when shut.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surge suppression devices before installation. Reject equipment that is damaged, or rusted, or have been subjected to water saturation.

B. Examine areas, surfaces, substrates, and elements to receive SPDs with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that field measurements are as indicated.
   2. Verify that manufacturer's written instructions for environmental conditions have been established in spaces where equipment will be installed, before installation begins.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install SPDs and accessories in accordance with manufacturer’s instructions.

B. Coordinate layout and installation of equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access.

C. Wall-Mounted Surge Protective Devices: Install SPDs on walls adjacent to equipment served, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For SPDs not at walls, mount to similar support structure for equipment served by device. Comply with Division 26 Section "Hangers and Supports for Electrical Systems."

D. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.

E. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
   1. Provide circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

F. Mount equipment plumb and rigid without distortion of enclosure.

G. Install fuses in fusible devices.

H. Comply with NECA 1.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Connect to building automation system according to Division 26 Section “Electrical Power Monitoring and Control.”

D. 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 for control wiring.

3.04 IDENTIFICATION

A. Nameplates: Label external device enclosures with equipment served.

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

C. Warning Labels: Label device with a warning label in accordance with NFPA 70 and NFPA 70E.

3.05 CLEANING

A. After completing equipment installation and before energizing, inspect unit components. Vacuum dirt and debris from interior of equipment; do not use compressed air to assist in cleaning. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.07 FIELD QUALITY CONTROL

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

B. Testing: Engage a qualified testing agency to perform the following field quality-control tests and inspections:

C. Testing: Perform the following field quality-control tests and inspections:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, to assist in testing, and to assist in adjusting device settings.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

E. Acceptance Testing Preparation:
1. After installing SPD but before equipment is energized, test for compliance with requirements.
2. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
3. Complete startup checks according to manufacturer's written instructions.
4. Test continuity of each circuit.

F. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Report results of tests and inspections in writing. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. SPDs will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.08 DEMONSTRATION

A. [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain equipment, overcurrent protective devices, instrumentation, and accessories.

B. Video record demonstrations presentation for Owner’s records.

END OF SECTION 264313

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SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. Included in the work of this section are labor, material, and appurtenances required to complete the work of this Section as specified herein, including, but not limited to:
   1. Interior light fixtures, lamps, LEDs, reflectors, lenses or faceplates, ballasts, transformers, drivers and power supplies (includes exterior light fixtures normally installed on exterior surfaces of buildings).
   2. Emergency lighting units.
   3. Exit signs.
   4. Light fixture supports.
   5. Coordination.
   6. Quality assurances.
   7. Specific requirements.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section "Exterior Lighting” for exterior light fixtures, except those normally mounted on exterior surfaces of buildings.

D. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

E. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.03 SUBMITTALS

A. General:
   1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, will be accepted. All light fixture shall be a direct buy as per the responsibility matrix on Architectural sheets.
   2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
   3. Prepare portfolios from manufacturer's standard specification sheets, and include the fixture tag indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
   4. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
   5. Modifications to fixtures shall be in accordance with Architect’s comments.

B. Product Data: For each type of light fixture, collated and bound in sets, and arranged in order of Lhight Fixture Schedule and fixture designation. Include data on features, accessories, finishes, and the following:
   1. Summary page with the following for each light fixture type
      a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
      b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.
   2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
      a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, fixture efficacy and/or efficiency, and verification of indicated parameters.
      b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
         1) Include MacAdam ellipse step information for:
            a) All interior light fixtures
            b) Exterior luminaires installed on exterior building surfaces specified with 80 CRI or greater.
   3. Light fixture mounting details, including non-standard outlet boxes.
   4. Construction of light fixture housing and door (if applicable).
   5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
   6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
   7. Light fixture finish and color (as approved by the Architect).
   8. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
      a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
   9. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.

C. Shop Drawings: Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components, features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.

D. Submittal Schedule
   1. Within 30 days of Division 26 contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.

2. Within 15 days of “approved” and “approved as noted” shop drawings, contractor shall forward to Architect a guaranteed ship date for each specified fixture.
3. Within 15 days after contractor’s receipt of “reject and resubmit” or “not approved” shop drawings, contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
4. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.

E. Control Wiring

F. Coordination Drawings: Refer to architectural reflected ceiling plans or details for exact location of light fixtures; engineering documents shall not be referenced for exact fixture positions. Contractor shall check and verify dimensions and details on drawings before proceeding with the work. If any question arises about the true meaning of drawings, refer the matter to the Architect, whose decision is final. In no case proceed with work with any uncertainty. Architectural documents shall show and coordinate with assistance from installers of items involved:
1. Light fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for light fixtures will be attached.
4. Other items in finished ceiling including the following:
5. Air outlets and inlets.
6. Speakers.
7. Sprinklers.
8. Smoke and fire detectors.
9. Occupancy sensors.
10. Access panels.

G. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

H. Qualification Data: For agencies providing photometric data for light fixtures.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.

K. Warranties: Special warranties specified in this Section.

1.04 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.05 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature

C. CRI: Color-rendering index.

D. CU: Coefficient of utilization.

E. EISA: Energy Independence and Security Act of 2007.

F. HID: High-intensity discharge.

G. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

H. LED: Light Emitting Diode

I. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

J. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

K. LER: Light fixture (Luminaire) efficiency rating.

L. Light Fixture: Complete light fixture, including ballast housing if provided.

M. RCR: Room cavity ratio.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   2. Marked for intended use.

B. Comply with NFPA 70.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

D. Regulatory Agencies: Provide fixtures conforming to nationally- or internationally-recognized accredited testing agencies, such as U.S., ETL, ARL, or others in acceptance with local code enforcement policy.

E. Electrical Components and Devices: Provide only fixtures that comply with National Electric Code (NEC), and in particular to Section 410. All ceiling recessed fixtures, whether indicated in a catalog number or not, shall be equipped with an integral thermal protection device.

1.07 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including, but not limited to, HVAC equipment, fire-suppression system, and partition assemblies. Contractor shall arrange his installation in proper relation to other work so that there shall be no interference, damage or delay to other trades' work

C. Give ample notice of any special openings or rough-in work required for placing electrical/lighting work so as to avoid cutting or removal of completed work.

D. Where work of this Section is to be flush or concealed, install it so it does not project beyond finished lines of walls, ceilings or floor surface.

E. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

1.08 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.10.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
   1. LED Luminaires, including LED modules, arrays and drivers: Five years.
   2. LED Lamps: Three years.

D. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining coverage years.
   2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: 7 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining coverage years.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Only those listed in the Light Fixture Schedule will be accepted. No substitutions shall be allowed as per Section 1.4.

2.02 LIGHT FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Provide light fixtures as shown on the drawings and/or specified. This shall include all lamps, material and labor to securely hang light fixtures, clean them and make them completely ready for use. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures. Provide additional tie wires connected to structure to conform to applicable seismic requirements where required.

B. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.

C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. Manufacturer of recessed fixtures shall provide mounting brackets suitable for connection to ceiling system structure. Modifications to standard mounting brackets shall be coordinated with contractor and delivered with fixture so that no delays to product delivery shall be allowed.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

H. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

I. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

J. Fixture Finishes:
1. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings, except chromium-plated or stainless steel parts, an even coat of high-grade meth/acrylate lacquer or transparent epoxy.
2. For corrosive or salt water environments, manufacturer shall provide fixtures with low copper/zinc cast aluminum (AB-47100 aluminum with less than 0.6% copper – classified for corrosive areas) housings to prevent salts from “pitting” aluminum housing. Manufacturer shall provide, in addition to or in lieu of, AB-47100 aluminum, ion added or pre-anodized polyester powder cast finish for “marine grade” applications. Manufacturer shall otherwise provide all stainless steel housing in conjunction with stainless steel hardware.
3. Recessed downlights in corrosive or salt water interior environments shall be equipped with a “natatorium” finish comprised of a zinc-chromated and phosphated process, then powder-coated on the exterior of the housing.

K. Reflectors:
1. Provide aluminum reflectors or reflecting cones for downlight style fixtures comprised of #12 aluminum reflector sheet, 0.57 inch (15 gauge) or heavier and free of tool-making indentations, including spinning lines caused by assembly techniques. All reflectors shall be of first-quality, anodized finish :Alzak” with specular or semi-specular finish and color as selected. Provide specular reflectors with no apparent brightness above 45 degrees from Nadir and semi-specular, diffuse reflectors with no apparent brightness above 75 degrees from Nadir.

L. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
a. "USE ONLY" and include specific lamp or LED type.
b. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.
c. CCT and CRI for all luminaires.

M. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate light fixtures with one filter on each ballast indicated to require a filter.

2.03 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.04 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.05 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
   1. Sound Rating: A.
   2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
   3. Transient Voltage Protection: IEEE C62.41, Category A or better.
   4. Power Factor: 0.90 or higher at full load.
   5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
   6. Driver shall operate with maximum sustained variations of +/-10% input voltage and frequency with no damage to driver.
   7. Driver output shall be regulated to maximum +/- 5% published load range or requirements of downstream LED fixture.
   8. LED Current Crest Factor: 1.5 or less.
   9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
   10. Meets EN610000 for input harmonics.
   11. ROHS Compliant.

B. Dimming Drivers:
   1. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
      a. Luminaires: 100 to 10 percent of rated lumens.
      b. Lamps: 100 to 20 percent of rated lumens.
   2. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
   3. Compatibility: Certified by manufacturer for use with specific dimming control system and LED indicated.
   4. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.06 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 80 CRI minimum and 3500K CCT.

B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values or as indicated in the Light Fixture Schedule, whichever is more stringent. All LEDs used for same fixture type throughout the project to originate from same production bin.

C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% maintained initial-rated lumens at average rated life of as follows:
   1. LED lamps: 20,000 hours
   2. LED luminaires: 50,0000 hours

D. ROHS compliant

E. Manufacturer of LED chips will be evaluated based on the manufacturer’s product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Cree, Nichia, Osram or

Xicato LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.07 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system. Where equipment is not indicated as plenum rated, provide an additional enclosure for the device(s) suitable for the installed environment.

2.08 LIGHT FIXTURE SUPPORT COMPONENTS

A. Comply with Sections “260548 Seismic Controls for Electrical” and “260529 - Hangers and Supports for Electrical Systems” for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.02 INSTALLATION

A. Light Fixtures: All work shall be executed to present a neat appearance. Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Support for Light Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from light fixture corners.
2. Support Clips: Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on light fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Light Fixture Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.
4. Decorative pendant mounted light fixtures
    a. Provide cord and/or stem lengths to match elevations above finished floor as indicated on architectural elevations. If architectural elevations do not indicate suspension heights, coordinate with Architect to determine final suspension heights. Regardless, contractor shall not field cut pendants or order rigid stems without elevation approval from Architect. Pendant suspensions on electrical documents are for reference only.
        1) Cord-mounted: Manufacturers shall supply luminaires with flexible, field cutting cords. Contractor shall field cut cords as required.
        2) Field-cuttable, rigid-stem mounted: Manufacturers shall supply luminaires with field cutting rigid stems. Contractor shall field cut stems as required.
        3) Factory-cut rigid stem mounted: Contractor shall provide rigid stem dimensions to the manufacturer as required.
    b. Junction boxes used to feed light fixtures shall be covered by manufacturer supplied canopy plates.

E. Installation within non-standard ceilings, including, but not limited to, wood and metal ceilings.
1. For recessed downlight light fixtures, specification is based on standard throats to accommodate ceiling thicknesses of ¾” or less. If non-standard ceiling (such as wood, thickened gypboard ceilings and metal plank type) require throats greater than ¾”, modifications to manufacturer’s standard ¾” throat shall be determined by Architect and Contractor prior to shop drawing submission.
2. For light fixtures recessed into metal ceilings, rigidly support light fixture to ensure that trim fits flush with ceiling plane.

F. Manufacturer shall supply contractor with a complete list of component elements to comply with design intent for either 20-amp (flexible low voltage track systems or line voltage track) or 50-amp bus bar track systems. Contractor shall install track systems based on design requirements outlined herein or Light Fixture Schedule.

G. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."

H. Through wiring of recessed light fixtures, in suspended ceilings, is not permitted. Connect each light fixture by a whip to a junction box. The whip shall be of sufficient length to allow the light fixture to be relocated within a 6-foot radius.

I. Wall Mounted Light fixtures
   1. Unless otherwise noted, conceal all raceways and back boxes for wall mounted light fixtures. Coordinate all wall-mounted light fixtures with interior elevations. Where specific elevations or dimensions are not indicated, verify the correct location with Architect prior to installation. Contractor shall supply structure to support weight of fixture.

J. Contractor shall construct light coves according to architectural details. Contractor shall ensure, unless otherwise directed, that top of fixture lamp is flush with top of cove lip. Contractor shall provide blocking as needed under fixture to ensure stated requirement.

K. Auxiliary Devices for low voltage and LED Fixtures
   1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
   2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well ventilated and accessible. Provide access panels as required.
   3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
   4. Properly support remote lighting devices, including transformers, power supplies, and drivers, per Code and manufacturer's recommendations.

3.03 MULTI-LEVEL SWITCHING

A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.

B. A similar multi-level lighting arrangement shall be provided where 4- and 3-way switches are shown. Where only one switch is shown at the alternate location it shall control the center lamp. Light fixtures indicated to have multi-level switching shall be furnished with the proper number of ballasts.

3.04 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
   1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
   2. 2-Wire dimming – two line voltage conductors plus ground
   3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
   4. DALI – two low voltage conductors and two line voltage conductors plus ground
   5. Proprietary digitally addressable – as required per the manufacturer
   6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.05 COORDINATION

A. Light fixtures shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings for exact locations.

B. Coordinate the installation and location of light fixtures with other work and all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.

C. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

D. Wall-Mounted Light fixtures
   1. Coordinate all wall-mounted light fixtures with the architectural features of the building. Where specific elevations or dimensions are not indicated, verify the correct location with the Architect prior to beginning any work.

3.06 ADJUSTING

A. Contractor shall adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

B. At the time of substantial completion, aim all track lights, flood lights, spot lights, and other fixtures requiring aiming per the Architect's direction. Contractor shall make provisions for supplying all scaffolds, lifts, and other tools and equipment as required.

C. Where required, focusing shall be done during hours of darkness. Upon notification by contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with contractor as to a mutually agreed upon time to complete focusing. Failure of contractor to notify Architect during substantial completion will result in failure to comply with specifications.

3.07 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, energize lighting branch circuits to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. At the time of final acceptance of this project by the Owner, ensure that all lamps are in working order and all light fixtures are fully lamped.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.08 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

3.09 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
   1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SECTION 265600
EXTERIOR AREA LIGHTING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following lighting equipment:
   1. Exterior LED light fixtures with LED modules and drivers.
   2. Light-fixture-mounted photoelectric relays.
   3. Poles and accessories.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section “Grounding and Bonding for Electrical Systems”

D. Division 26 Section “Raceway and Boxes for Electrical Systems.

E. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”

F. Division 26 Section “Vibration and Seismic Controls for Electrical Systems”

G. Division 26 Section “Indentification for Electrical Systems”

H. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

I. Division 26 Section "Wiring Devices" for devices installed in poles.

J. Division 26 Section “Fuses”

K. Division 26 Section “Enclosed Switches and Circuit Breakers”

L. Division 26 Section “Interior Lighting” for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 SUBMITTALS

A. General:
   1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, will be accepted. All light fixture shall be a direct buy through NESCO Inc. – Sprouts National Account as directed by the Responsibility Matrix on the architectural drawings. Contact Nancy Ramdon-Connolly, Tel.: (415) 307-8579, Email: sprouts@needhamelectric.com.

2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.

B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
   1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
   2. Modifications to fixtures shall be in accordance with Architect’s comments.

C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Summary page with the following for each light fixture type
      a. The number, type and wattage of LEDs (including, but not limited to, assemblies, arrays, bars or modules).
      b. Light fixture driver or auxiliary device manufacturer, number and type.
   2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
      a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
      b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
         1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.
   3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
   4. Construction of light fixture housing and door (if applicable).
   5. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
      a. For dimming LED, also include dimming type technology and dimming range/limits.
   6. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
      a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
   7. Details of attaching light fixtures and accessories.
   8. Details of installation and construction.
   9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
      a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
   10. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.
   11. Photoelectric relays.
   12. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.

D. Qualification Data: For Installer, manufacturer, light fixture photometric data testing laboratory, and field testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For light fixtures and poles to include in operation and maintenance manuals.

G. Warranty: Special warranties specified in this Section.

1.04 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.05 DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. CV: Coefficient of Variance. The ratio of standard deviation for all illuminance values to the mean illuminance value.

E. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.

F. EISA: Energy Independence and Security Act of 2007.

G. Horizontial Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches above the ground, unless otherwise indicated.

H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

I. LED: Light Emitting Diode

J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

L. LER: Light fixture efficacy rating.

M. Light fixture: Complete light fixture, including ballast housing if provided.

N. LLD: Lamp Lumen Depreciation.

O. LLF: Light Loss Factor.

P. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.

B. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.07 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

1.08 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
   1. LED Luminaires, including LED modules, arrays and drivers: Five years.

2. LED Lamps: Three years.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
   1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 5 years from date of Substantial Completion.
   2. Warranty Period for Metal Corrosion: Free from defects in materials and workmanship for a period of 5 years from date of Substantial Completion.
   3. Warranty Period for Color Retention: Free of fading for a period of 5 years from date of Substantial Completion.
   4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
   5. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 3 years from date of Substantial Completion.
   6. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 12 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warrranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realighnment.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Only those listed in the Light Fixture Schedule will be accepted.

2.02 LIGHT FIXTURES, GENERAL REQUIREMENTS

A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.

C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

M. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

N. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.

O. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    a. Color: As selected by Architect from manufacturer’s range.

P. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: As selected by the Architect from manufacturer's range.

Q. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
    a. "USES ONLY" and include specific lamp or LED type.
    b. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.
    c. For LED luminaires, includes CCT and CRI.

2.03 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Power Factor: 0.90 or higher at full load.
5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
6. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.
7. Driver output shall be regulated to +/- 5% published load range.
8. LED Current Crest Factor: 1.5 or less.
9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
10. Meets EN610000 for input harmonics.
11. ROHS Compliant.
12. Suitable for use in outdoor light fixtures.
13. Dimming Drivers
    a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
        1) Luminaires: 100 to 10 percent of rated lumens.
        2) LED Lamps: 100 to 20 percent of rated lumens.
    b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
    c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
    d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.04 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.

B. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:
   1. LED outdoor pole mounted area lights: 100,000 hours
   2. LED lamps: 20,000 hours
   3. Other LED luminaires: 50,000 hours

C. ROHS compliant

D. Manufacturer of LED chips will be evaluated based on the manufacturer's product literate and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.05 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

2.06 LIGHT FIXTURE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with NEMA C136.10.
   2. Adjustable window slide for adjusting on-off set points.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.02 LIGHT FIXTURE INSTALLATION

A. Install lamps in each light fixture.

B. Fasten light fixture to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust light fixtures that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

D. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light and glare measurements.

E. Auxiliary devices for low voltage and LED fixtures installation
1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
5. Provide enclosures suitable for installation environment as required.

3.03 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect’s direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

H. Illumination Tests Areas other than Sports Playing Fields:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
      a. IESNA LM-64, "Photometric Measurements of Parking Areas."
      b. IESNA LM-72, "Directional Positioning of Photometric Data."

I. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600

SECTION 265600
EXTERIOR AREA LIGHTING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following lighting equipment:
   1. Exterior LED light fixtures with LED modules and drivers.
   2. Light-fixture-mounted photoelectric relays.
   3. Poles and accessories.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section “Grounding and Bonding for Electrical Systems”

D. Division 26 Section “Raceway and Boxes for Electrical Systems.

E. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”

F. Division 26 Section “Vibration and Seismic Controls for Electrical Systems”

G. Division 26 Section “Indentification for Electrical Systems”

H. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

I. Division 26 Section "Wiring Devices" for devices installed in poles.

J. Division 26 Section “Fuses”

K. Division 26 Section “Enclosed Switches and Circuit Breakers”

L. Division 26 Section “Interior Lighting” for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 SUBMITTALS

A. General:
   1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, will be accepted. All light fixture shall be a direct buy through NESCO Inc. – Sprouts National Account as directed by the Responsibility Matrix on the architectural drawings. Contact Nancy Ramdon-Connolly, Tel.: (415) 307-8579, Email: sprouts@needhamelectric.com.

2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.

B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
   1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
   2. Modifications to fixtures shall be in accordance with Architect’s comments.

C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Summary page with the following for each light fixture type
      a. The number, type and wattage of LEDs (including, but not limited to, assemblies, arrays, bars or modules).
      b. Light fixture driver or auxiliary device manufacturer, number and type.
   2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
      a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
      b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
         1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.
   3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
   4. Construction of light fixture housing and door (if applicable).
   5. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
      a. For dimming LED, also include dimming type technology and dimming range/limits.
   6. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
      a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
   7. Details of attaching light fixtures and accessories.
   8. Details of installation and construction.
   9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
      a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
   10. For pole-mounted LED area lighting fixtures, IES-TM-21 LED luminaire lifetime and lumen maintenance projections.
   11. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.
   12. Photoelectric relays.

13. Materials, dimensions, and finishes of poles.
14. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.
15. Anchor bolts for poles.
16. Manufactured pole foundations.

D. Delegated-Design Submittals for Pole-Mounted Area Lighting: Submit the following documents, signed and sealed by a qualified professional engineer:
   1. Structural analysis data and calculations used for pole selection and foundations.
      a. Manufacturer Seismic Qualification Certification: Submit certification that lighting components and their mounting and anchorage provisions are designed to remain in place with out separation of any parts when subject to seismic forces defined in Division 26 Section "Vibration and Seismic and Seismic Controls for Electrical Systems" Include the following:
         1) Basis for Certification: Indicate whether withstand certifications are based on actual test of assembled components or calculation.
         2) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
      b. Manufacturer Wind-Load Strength Certification: Submit certification that selected total support system, including poles and equipment anchorage devices, complies with AASHTO LTS-4 or as required by the local authority having jurisdication, whichever is more stringent, for location of project.
   2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
   3. Design calculations for the following:
      a. Design calculations indicating strength of screw foundations and soil conditions on which they are based.
      b. Design calculations for determination of poured-in-place concrete foundation size and reinforcement
   4. Shop Drawings:Submittal Schedule
      a. Within 30 days from Division 26 Contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
      b. Within 15 days of "approved" and "approved as noted" shop drawings, Contractor shall forward to Architect a guaranteed ship date for each specified fixture.
      c. Within 15 days after Contractor's receipt of "reject and resubmit" or "not approved" shop drawings, Contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
      d. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
   5. Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components, features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.
   6. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
   7. Wiring Diagrams: Power and control wiring.

E. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 or as noted elsewhere in this specification and that loads imposed by light fixtures and attachments have been included in design. This certification shall be based on design calculations by a professional engineer.

F. Qualification Data: For Installer, manufacturer, light fixture photometric data testing laboratory, and field testing agency.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For light fixtures and poles to include in operation and maintenance manuals.

I. Warranty: Special warranties specified in this Section.

1.04 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.05 DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. CV: Coefficient of Variance. The ratio of standard deviation for all illuminance values to the mean illuminance value.

E. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.

F. EISA: Energy Independence and Security Act of 2007.

G. Horizontial Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches above the ground, unless otherwise indicated.

H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

I. LED: Light Emitting Diode

J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

L. LER: Light fixture efficacy rating.

M. Light fixture: Complete light fixture, including ballast housing if provided.

N. LLD: Lamp Lumen Depreciation.

O. LLF: Light Loss Factor.

P. Luminaire: Complete lighting fixture, including ballast housing if provided.

Q. Pole: Light fixture support structure, including tower used for large area illumination.

R. Standard: Same definition as "Pole" above.

1.06 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of light fixture and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in latest AASHTO LTS-4.

B. Live Load: Single load of 500 lbf, distributed as stated in latest AASHTO LTS-4.

C. Ice Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.

D. Wind Load: As stated in latest AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this project.

B. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.08 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

1.09 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
   1. LED Luminaires, including LED modules, arrays and drivers: Five years.
   2. LED Lamps: Three years.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
   1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 5 years from date of Substantial Completion.
   2. Warranty Period for Metal Corrosion: Free from defects in materials and workmanship for a period of 5 years from date of Substantial Completion.
   3. Warranty Period for Color Retention: Free of fading for a period of 5 years from date of Substantial Completion.
   4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
   5. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 3 years from date of Substantial Completion.
   6. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 12 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warrranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realighnment.
   7. Warranty for Pole-Mounted LED Area Lights: Light fixture (including LEDs and drivers) and pole will be free of defects in material and workmanship for a period of ten years from date of product purchase.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation.

D. Handle all poles with web fabric straps.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Manufacturers: Only those listed in the Light Fixture Schedule will be accepted.

2.02 LIGHT FIXTURES, GENERAL REQUIREMENTS

A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.

C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

M. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

N. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.

O. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    a. Color: As selected by Architect from manufacturer’s range.

P. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: As selected by the Architect from manufacturer’s range.

Q. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
    a. “USES ONLY” and include specific lamp or LED type.
    b. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.

c. For LED luminaires, includes CCT and CRI.

2.03 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
   1. Sound Rating: A.
   2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
   3. Transient Voltage Protection: IEEE C62.41, Category A or better.
   4. Power Factor: 0.90 or higher at full load.
   5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
   6. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.
   7. Driver output shall be regulated to +/- 5% published load range.
   8. LED Current Crest Factor: 1.5 or less.
   9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
   10. Meets EN610000 for input harmonics.
   11. ROHS Compliant.
   12. Suitable for use in outdoor light fixtures.
   13. Dimming Drivers
      a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
         1) Luminaires: 100 to 10 percent of rated lumens.
         2) LED Lamps: 100 to 20 percent of rated lumens.
      b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
      c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
      d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.04 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.

B. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:
   1. LED outdoor pole mounted area lights: 100,000 hours
   2. LED lamps: 20,000 hours
   3. Other LED luminaires: 50,000 hours

C. ROHS compliant

D. Manufacturer of LED chips will be evaluated based on the manufacturer's product literate and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.05 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

2.06 LIGHT FIXTURE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with NEMA C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.07 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.
   1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article.
   2. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M or ASTM A 153/A 153M unless stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, 3000-psi (28-day minimum compressive strength, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to

ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, light fixture(s), and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.08 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
   1. Shape: As indicated in the Light Fixture Schedule.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: As indicated in the Light Fixture Schedule type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Light Fixtures: Detachable, cantilever, without underbrace.
   1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate light fixture.
   3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

H. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.

I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

J. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As selected by Architect from manufacturer's full range.

2.09 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
   1. Shape: As indicated in the Light Fixture Schedule.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Light fixtures: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
   1. Tapered oval cross section, with straight tubular end section to accommodate light fixture.
   2. Finish: Same as light fixture.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
   1. Color: As selected by Architect from manufacturer's full range.

2.10 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.02 LIGHT FIXTURE INSTALLATION

A. Install lamps in each light fixture.

B. Fasten light fixture to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust light fixtures that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

D. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light and glare measurements.

E. Auxiliary devices for low voltage and LED fixtures installation
1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
5. Provide enclosures suitable for installation environment as required.

3.03 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.04 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of light fixtures and their mounting provisions on the pole. Install poles and other structural units level, plumb, and square.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
   2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space. Grout materials, installation, and finishing requirements are specified in Division 05 Section “Metal Fabrications”.
   3. Install base covers, unless otherwise indicated.
   4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
   1. Make holes 6 inches in diameter larger than pole diameter.
   2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
   3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
   4. Cure concrete a minimum of 72 hours before performing work on pole.

F. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
   1. Install protective pipe bollards on three sides of each embedded pole installed in paved areas. Refer to Division 05 “Metal Fabrications” for pipe bollards.

G. Raise and set poles using web fabric slings (not chain or cable).

3.05 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

3.06 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole, unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting light fixture to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.07 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect’s direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

H. Illumination Tests Areas other than Sports Playing Fields:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
      a. IESNA LM-64, "Photometric Measurements of Parking Areas."
      b. IESNA LM-72, "Directional Positioning of Photometric Data."

I. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600

SECTION 265600
EXTERIOR AREA LIGHTING

PART 1 GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following lighting equipment:
   1. Exterior LED light fixtures with LED modules and drivers.
   2. Light-fixture-mounted photoelectric relays.
   3. Poles and accessories.

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section “Grounding and Bonding for Electrical Systems”

D. Division 26 Section “Raceway and Boxes for Electrical Systems.

E. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”

F. Division 26 Section “Vibration and Seismic Controls for Electrical Systems”

G. Division 26 Section “Indentification for Electrical Systems”

H. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

I. Division 26 Section "Wiring Devices" for devices installed in poles.

J. Division 26 Section “Fuses”

K. Division 26 Section “Enclosed Switches and Circuit Breakers”

L. Division 26 Section “Interior Lighting” for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 SUBMITTALS

A. General:
   1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, will be accepted. All light fixture shall be a direct buy through NESCO Inc. – Sprouts National Account as directed by the Responsibility Matrix on the architectural drawings. Contact Nancy Ramdon-Connolly, Tel.: (415) 307-8579, Email: sprouts@needhamelectric.com.

2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.

B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
   1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
   2. Modifications to fixtures shall be in accordance with Architect's comments.

C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Summary page with the following for each light fixture type
      a. The number, type and wattage of LEDs (including, but not limited to, assemblies, arrays, bars or modules).
      b. Light fixture driver or auxiliary device manufacturer, number and type.
   2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
      a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
      b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
         1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.
   3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
   4. Construction of light fixture housing and door (if applicable).
   5. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
      a. For dimming LED, also include dimming type technology and dimming range/limits.
   6. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
      a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
   7. Details of attaching light fixtures and accessories.
   8. Details of installation and construction.
   9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
      a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
   10. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.
   11. Photoelectric relays.
   12. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.

D. Qualification Data: For Installer, manufacturer, light fixture photometric data testing laboratory, and field testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For light fixtures and poles to include in operation and maintenance manuals.

G. Warranty: Special warranties specified in this Section.

1.04 SUBSTITUTIONS

A. Refer to Division 26 Section “General Electrical Requirements”.

B. Substitutions: **NO SUBSTITUTIONS, THIS IS A NATIONAL ACCOUNT ITEM.**

1.05 DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. CV: Coefficient of Variance. The ratio of standard deviation for all illuminance values to the mean illuminance value.

E. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.

F. EISA: Energy Independence and Security Act of 2007.

G. Horizontial Illuminance: Measurement in foot-candles (lux), on a horizontal surface 36 inches above the ground, unless otherwise indicated.

H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

I. LED: Light Emitting Diode

J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.

K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

L. LER: Light fixture efficacy rating.

M. Light fixture: Complete light fixture, including ballast housing if provided.

N. LLD: Lamp Lumen Depreciation.

O. LLF: Light Loss Factor.

P. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.

B. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.07 COORDINATION

A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

1.08 WARRANTY

A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
   1. LED Luminaires, including LED modules, arrays and drivers: Five years.
   2. LED Lamps: Three years.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
   1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 5 years from date of Substantial Completion.
   2. Warranty Period for Metal Corrosion: Free from defects in materials and workmanship for a period of 5 years from date of Substantial Completion.
   3. Warranty Period for Color Retention: Free of fading for a period of 5 years from date of Substantial Completion.
   4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
   5. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 3 years from date of Substantial Completion.
   6. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 12 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warrranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realighnment.

PART 2 PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Only those listed in the Light Fixture Schedule will be accepted.

2.02 LIGHT FIXTURES, GENERAL REQUIREMENTS

A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.

C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

M. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.

N. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.

O. Factory-Applied Finish for Steel Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    a. Color: As selected by Architect from manufacturer’s range.

P. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: As selected by the Architect from manufacturer's range.

Q. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
    a. "USES ONLY" and include specific lamp or LED type.
    b. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.
    c. For LED luminaires, includes CCT and CRI.

2.03 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Power Factor: 0.90 or higher at full load.
5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
6. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.
7. Driver output shall be regulated to +/- 5% published load range.
8. LED Current Crest Factor: 1.5 or less.
9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
10. Meets EN610000 for input harmonics.
11. ROHS Compliant.
12. Suitable for use in outdoor light fixtures.
13. Dimming Drivers
    a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
        1) Luminaires: 100 to 10 percent of rated lumens.
        2) LED Lamps: 100 to 20 percent of rated lumens.
    b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
    c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
    d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.04 LED LAMPS AND LUMINAIRES

A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.

B. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:
   1. LED outdoor pole mounted area lights: 100,000 hours
   2. LED lamps: 20,000 hours
   3. Other LED luminaires: 50,000 hours

C. ROHS compliant

D. Manufacturer of LED chips will be evaluated based on the manufacturer's product literate and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desireable.

2.05 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

2.06 LIGHT FIXTURE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with NEMA C136.10.
   2. Adjustable window slide for adjusting on-off set points.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions of equipment and installation prior to beginning work.

B. Verify that equipment is ready for connecting, wiring, and energizing.

3.02 LIGHT FIXTURE INSTALLATION

A. Install lamps in each light fixture.

B. Fasten light fixture to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust light fixtures that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

D. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light and glare measurements.

E. Auxiliary devices for low voltage and LED fixtures installation
1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
5. Provide enclosures suitable for installation environment as required.

3.03 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.

E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

H. Illumination Tests Areas other than Sports Playing Fields:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
      a. IESNA LM-64, "Photometric Measurements of Parking Areas."
      b. IESNA LM-72, "Directional Positioning of Photometric Data."

I. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600

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DIVISION 28 - ELECTRONIC SAFETY & SECURITY SPECIFICATION

284600 FIRE DETECTION AND ALARM

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SECTION 284600
FIRE DETECTION AND ALARM

PART 1 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
   2. Division 26 Section "Common Work Results for Electrical," for materials and methods for coordination, sleeves and common installation requirements.

1.02 DESCRIPTION OF WORK

A. This Section requires the Contractor to furnish all materials required to install the fire alarm system. The Contractor shall be responsible for installing, testing, and start-up of a complete functioning fire alarm system, and each element thereof, as specified or indicated on the Drawings or reasonably inferred, including every article, device or accessory (whether or not specifically called for by item) necessary to facilitate each system's function as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation and utilities.

B. Division 28 of the Specifications and Drawings numbered with prefixes FA generally describe these systems, but the scope of the Fire Alarm work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically and are intended to convey the scope of work, indicating the general location and arrangement of the major equipment, devices, appliances, etc. without showing all the exact details as to elevations, circuits, routing, and other installation requirements. Use the Drawings as a guide when laying out the system and verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

D. The scope of work in this section includes:
   1. Fire alarm control unit
   2. Remote annunciator
   3. Manual fire alarm pull stations
   4. System smoke detectors
   5. Notification appliances
   6. Sprinkler system waterflow and valve tamper alarms
   7. Air handling unit shutdown
   8. Battery stand-by power

9. Digital Alarm Communicator Transmitter

1.03 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Installation of devices shall be performed or supervised by a National Institute for Certification of Engineering Technologies (NICET) Level 2 or higher Fire Alarm Technician. Submit copies of the certification for employees through shop drawing submittals.

1.04 APPLICABLE CODES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities. Upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
1. NFPA 70, "National Electrical Code", 2020 Edition.
2. NFPA 72, "National Fire Alarm and Signaling Code", 2019 Edition.
3. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
4. Florida Building Code, 8th Edition.
5. Florida Fire Prevention Code, 8th Edition.

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

1.05 DEFINITIONS

A. General:
   1. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
   2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
   3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
   4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
   5. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the AHJ over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
   6. FACP: Fire Alarm Control Panel.
   7. NICET: National Institute for Certification in Engineering Technologies.

B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

1.06 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.

C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Fire Alarm systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in

conformance with the construction schedule so as to ensure successful achievement of schedule dates.

E. Where coordination and interfacing with other systems or equipment is required, it shall be the responsibility of the fire alarm system installer (contractor) to either provide the relays, contacts, power supplies and other necessary hardware or see to it that such hardware is provided with the other systems or equipment.

F. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:
   1. Sprinkler waterflow and valve tamper switches shall be provided by the fire sprinkler installer but wired and connected by the fire alarm installer.
   2. Duct smoke detectors shall be factory installed and connected by the fire alarm system installer. The HVAC installer shall furnish necessary duct opening to install the duct smoke detector's housing.
   3. Air handling fan control circuits and contacts to be furnished by the HVAC control equipment.
   4. Conduit shall be by Division 26 "Common Work Results for Electrical".

G. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.07 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.08 SUBMITTALS

A. Refer to Division 1 and General Conditions for submittal requirements, in addition to requirements specified herein. Submittals not complying fully with the submittal requirements will be rejected.

B. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval.

C. Shop drawings shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations. Drawings that are not legible, or that do not contain sufficient detail to verify compliance with applicable codes and standards, will be rejected without further review.

D. Submittals and shop drawings shall not contain HEI's firm name or logo, nor shall it contain the HEI's engineers' seal and signature. They shall not be copies of HEI's work product. If the

contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.

E. Submit Shop Drawings as early as required to support the project schedule. Allow for two weeks Engineer review time plus mailing time plus a duplication of this time for resubmittal if required. Submit Shop Drawings as soon as possible before construction starts.

F. Before submitting Shop Drawings and material lists, the Contractor shall verify that the equipment submitted is mutually compatible and suitable for the intended use. Contractor shall verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

G. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the shop drawings have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials, performance criteria and accessories being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

H. The Engineer's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Engineer's and Architect's attention to such deviations at the time of submission, and secured written acceptance; nor shall it relieve him from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.

I. Product Data: Provide a bill of materials and product cutsheets showing material specifications, electrical characteristics and connection requirements. Highlight or indicate specific product options and accessories as applicable to the project.

J. Shop Drawings:
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Shop drawings shall be prepared by a NICET Level II or higher certified technician. Submit copies of the certification for the designer with submittal.
   3. The fire alarm system equipment vendor shall provide shop drawings showing fire alarm floor plans and a full building riser diagram. Fire alarm floor plans and riser diagram shall show fire alarm control panel, annunciator, all fire alarm initiating devices and notification appliances. Show typical wiring diagrams of control panel/s, annunciator and each device and wiring connections required. Show all interfaces to other systems, such as temperature control systems, and security systems.
   4. The fire alarm floor plans and riser diagram shall show wiring to all fire alarm devices/appliances, indicating wire sizes and quantities as well as conduit/raceway sizes and locations of end-of-line (EOL) resistors. The fire alarm floor plans and riser diagram

shall clearly show the routing of all fire alarm system wiring, including all horizontal routing and vertical routing (in chases).

5. Routing of all fire alarm wiring shall comply with the “Survivability” requirements of NFPA 72.
6. Provide a Sequence of Operations Matrix that explains how the submitted fire alarm system functions.
7. Include voltage drop calculations for notification-appliance circuits.
8. Include battery-size calculations.
9. Shop drawing scale shall match the Engineer’s drawings where possible. Scale shall not be less than 3/32" = 1’-0".
10. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.

K. Indicate within the submittal all applicable UL listings and all applicable approvals or certifications.

L. Qualification Data: Submit copies of the certification for the Installer.

M. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.09 ELECTRONIC DRAWING FILES

A. In preparation of shop or record drawings, Contractor may, at his option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for Architect’s written authorization. Contractor shall complete and send the form attached at the end of this section along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect’s written authorization and Engineer’s release agreement form must be received before electronic drawing files will be sent.

1.10 SUBSTITUTIONS

A. Refer to Division 1 and General Conditions for Substitutions.

B. Materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten calendar days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Engineer's decision of approval or disapproval to bid of a proposed substitution shall be final.

D. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.

E. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.11 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1 and General Conditions for Operational and Maintenance Manuals.

B. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

C. The O&M Manuals shall be provided in labeled 3-ring binder with cover, binding label, tabbed fly sheets and plastic insert folders for Record Drawings. Include the following sections with the appropriate information for each section:
   1. Typewritten Index.
   2. Qualifications. Provide designer and installer qualification.
   3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
   4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
   5. Product Data: Provide product cutsheets for all equipment utilized and installed.
   6. Riser diagram.
   7. Device addresses.
   8. Record copy of site-specific software.
   9. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      a. Equipment tested.
      b. Frequency of testing of installed components.
      c. Frequency of inspection of installed components.
      d. Requirements and recommendations related to results of maintenance.
      e. Manufacturer's user training manuals.
   10. Manufacturer's required maintenance related to system warranty requirements.
   11. Abbreviated operating instructions for mounting at fire alarm control unit and each annunciator unit.
   12. Guarantee. Copy of all guarantees and warranties issued.
   13. Contact list with minimum three service representative phone numbers.

1.12 RECORD DRAWINGS

A. A set of prints shall be kept on the jobsite during construction for the purpose of noting changes to location of all fire alarm equipment, devices, appliances and circuits as finally installed. During the course of construction, the Contractor shall indicate on these drawings, changes made from the Contract Drawings. Particular attention shall be made to those items which need to be located for servicing.

B. The record drawings shall show actual locations of initiating devices, notification appliances, and end-of-line devices. Show the approximate location, size and type of all wiring and routing of wiring. Drawings should also include one-line riser diagrams showing all devices.

C. The Contractor shall sign-off on the Record Drawings as being an accurate representation of the completed installation.

D. Refer to Division 1 and General Conditions for Record Drawings

E. At the completion of the project, the Contractor shall obtain at his expense, reproducible copies of the drawings and incorporate changes noted on the jobsite work prints onto these sheets. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", with date. The drawings and associated system calculations shall be delivered to the Architect/Engineer.

1.13 SPARE PARTS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Provide 10% of the total or a minimum of one (1) manual pull station.
   2. Provide 10% of the total or a minimum of one (1) of each type of automatic smoke detector.
   3. Provide 5% of the total or a minimum of two (2) of each strobe type and candela rating.
   4. Provide 5% of the total or a minimum of two (2) of each horn type. Combination horn /strobe units matching the units installed are acceptable.
   5. Keys and Tools: One extra set for access to locked or tamper proofed components.

1.14 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products indicated in this section with minimum three years documented experience.

B. Installer: Company specializing in installing the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed Contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire alarm submittal proof of factory training for each installer.

C. Final checkout and verification: Shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET) registered as level 2 or higher in the fire protection technology certification program. Provide certification information with fire alarm submittal.

D. The equipment manufacturer's service department shall be fully stocked in standard parts and components and engaged in the maintenance of fire alarm systems. On-the-premises service shall be available within 4 hours of notification, 7 days a week, 24 hours a day.

1.15 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties.

B. Furnish service and maintenance of fire alarm system including wiring and raceways for one year from date of substantial completion.

C. All components, system software, parts and assemblies shall be guaranteed against defects in materials and workmanship for the one-year period stated above, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty.

D. Labor (including travel expenses) to trouble-shoot, repair, reprogram, or replace components shall be furnished by this contractor at no charge during the warranty period.

E. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software.

PART 2 PRODUCTS AND MATERIALS

2.01 SYSTEM DESCRIPTION

A. Noncoded, UL-listed addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. All components provided shall be listed for use with the selected system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Source Limitations for Fire alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested, and will operate, as a system.

2.02 MANUFACTURER

A. Subject to compliance with requirements, provide products manufactured by the following manufacturers as indicated on the Drawings:
   1. Silent Knight
      a. Model: 6820
   2. Fire-Lite
      a. Model: ES-50X

2.03 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire alarm signal initiation shall be by one or more of the following devices:
   1. Manual pull stations.
   2. Smoke detectors.
   3. Automatic sprinkler system water flow.
   4. Fire extinguishing system operation.

B. Fire alarm signal shall initiate the following actions:
   1. Identify alarm and specific initiating device at fire alarm control unit and remote annunciators (if provided).
      a. A pulsing alarm tone shall occur within the control panel until acknowledged.
      b. The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the

address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.

2. Transmit an alarm signal to the alarm supervising station.
3. Audible notification appliances shall sound until silenced by the alarm silence switch at the control panel.
4. All visible alarm notification appliances shall display a continuous synchronized pattern until reset by the Alarm Reset Switch.
5. Record events in the system memory.
6. All fan-powered air-handling equipment shall shutdown and remain down until the fire alarm control panel is reset.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. Duct-smoke detectors
3. Loss of communication with any panel on the network.

D. System Supervisory Signal Actions:
1. Identify specific device causing supervisory signal fire alarm control unit and remote annunciators (if provided).
   a. Visible and audible supervisory alarm indicated by address at fire alarm control panel.
   b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible supervisory alarm; visible alarm is displayed until device is returned to its normal position/supervisory condition is cleared.
2. Record events in the system memory.
3. After a timed delay of 90 seconds transmit a supervisory signal to the alarm supervising station.
4. Duct-mounted smoke detectors shall shutdown their respective unit upon detection of smoke and remain down until manually reset.
5. Individual fan-powered air distribution equipment less than 2,000 cfm that is not provided with duct detection shall shutdown when the respective air handling unit is shutdown.

E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire alarm control unit.
5. Ground or a single break in internal circuits of fire alarm control unit.
6. Abnormal ac voltage at fire alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire alarm control unit or annunciator.

F. System Trouble Signal Actions:
1. Identify specific device causing trouble signal fire alarm control unit and remote annunciators (if provided).
   a. Visible and audible trouble alarm indicated by address at fire alarm control panel.

b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible trouble alarm; visible alarm is displayed until device is returned to its normal position/trouble condition is cleared.

2. Record events in the system memory.
3. After a timed delay of 90 seconds, transmit a trouble signal to the alarm supervising station.

2.04 FIRE ALARM SYSTEM CONTROL UNIT

A. General Requirements for Fire alarm Control Unit:
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
      a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
      b. Include a real-time clock for time annotation of events on the event recorder and printer.
      c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
      d. The FACP shall be listed for connection to a central-station signaling system service.
      e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
      f. The control unit shall have dedicated alarm, supervisory and trouble LED’s and dedicated alarm, supervisory and trouble acknowledge, and alarm silence switches.
      g. Lamp Test: Manual lamp test function causes each LED to function at fire alarm control panel.
      h. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.
      i. The FACP shall be provided with surge protection.
      j. Install in a surface mounted enclosure.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
   2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the class of the circuitry selected.
   1. Initiating Device Circuits: Class B.
      a. Pathway Survivability: Level 0.
   2. Notification Appliance Circuits: Class B.
      a. Pathway Survivability: Level 0.
   3. Signaling Line Circuits: Class B.
      a. Pathway Survivability: Level 0

4. Any circuits interconnecting fire alarm control panels between separate buildings shall be provided with surge protection.

D. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. The location of the dedicated branch circuit disconnecting means shall be permanently identified at the control unit.
2. The circuit disconnecting means shall have a red marking and be provided with a breaker lock or other approved method to avoid accidental operation.
3. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

E. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead acid.
2. The secondary power system shall operate system in standby mode for 24 hours followed by alarm mode for 5 minutes.

F. System Supervision: Automatically detects and reports open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits. Alarm, supervisory and trouble signals shall be monitored by the supervising station over a Digital Alarm Communicator Transmitter (DACT), or other approved method.

2.05 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter (DACT) shall be acceptable to the remote or central station and shall comply with UL 864.

B. The installing contractor shall select the appropriate DACT equipment based on the available communication methods.

C. Coordinate with General Contractor to ensure proper connections are provided for communication to and from the DACT.
1. One (1) communication method is required, in most cases, and shall not be subject to a common failure within the scope of work identified within these contract documents.
   a. GSM cellular networks in the area including 5G, 4G and LTE.
      1) The transmitter shall automatically detect and choose the best network in the area based on signal strength and immediately self-adjust for operation as necessary.
      2) Cellular communicator shall be Telguard model TG7FS.
2. When (2) communication methods are required by the authority having jurisdiction and shall not be subject to a common failure within the scope of work identified within these contract documents.
   a. GSM cellular networks in the area including 5G, 4G and LTE.
      1) The transmitter shall automatically detect and choose the best network in the area based on signal strength and immediately self-adjust for operation as necessary.
      2) Cellular communicator shall be Telguard model TG7FE.
   b. Building 10/100 Base network (LAN), DSL modem, or cable modem.

c. Other alternative method complying with the performance requirements of NFPA 72 for 'Communication Methods for Supervising Station Alarm Systems that is acceptable to the Authority Having Jurisdiction and the Engineer of Record. Approval of any alternative methods must be obtained from the Engineer of Record via an RFI prior to submitting bids for the scope of work.

d. Analog Copper wire (POTS) telephone line for fire alarm use as required by NFPA 72.
   1) If two (2) POTS telephone lines are utilized per NFPA 72, additional communication methods are not required.
   2) This method shall be chosen as a last option and only should be provided if the AHJ does not allow the other above methods.

D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire alarm control unit and automatically transmit across the primary communication method. If service on the primary communication method is interrupted for longer than 45 seconds, the transmitter shall initiate a local trouble signal and transmit a signal indicating loss of primary communication to the supervising station over the secondary communication method. Transmitter shall automatically report communication restoration to the supervising station. If service is lost on both communication methods, transmitter shall initiate a local trouble signal.

E. Digital data transmission shall include the following:
   1. Address of the alarm initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble signal.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.
   8. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to supervising station.

2.06 REMOTE ANNUNCIATOR

A. Description: Alphanumeric display and LED indicating lights shall match those of fire alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
   1. Mounting: Flush.

2.07 INITIATING DEVICES

A. Manual Fire Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Double action mechanism requiring two actions to initiate an alarm, pull lever type; with integral addressable module arranged to communicate manual station status (normal, alarm, or trouble) to fire alarm control unit.

2. Station Reset: Key or wrench operated switch.
3. Indoor Protective Shield: Factory fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

B. System Smoke Detectors: Photoelectric type complying with UL 268 operating at 24-V dc, nominal with integral addressable module arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
1. Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
2. Device shall have an integral visual-indicating light, LED type, indicating detector has operated and power-on status.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Photoelectric detectors shall have sensitivity between 0.5 and 3.5 percent/foot smoke obscuration.

2.08 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
1. Combination Devices: Factory integrated audible and visible devices in a single mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections. Minimum audible level and strobe intensity shall meet all requirements for separate appliances.
2. Provide strobe synchronization as required per NFPA 72.
3. Wall mounted notification appliances shall be manufacturer standard white finish.
4. Ceiling mounted notification appliances shall be manufacturer standard white finish.

B. Alarm Horns: Comply with UL 464. Electric vibrating polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Alarm Notification Appliances (Strobes): Xenon strobe lights complying with UL 1971, unfiltered or clear filtered white light, with candela ratings as indicated on drawings. Strobes shall meet all requirements of the Americans with Disabilities Act.

2.09 AUXILIARY DEVICES

A. Waterflow Alarm Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer. Switch shall have an adjustable delay to minimize false alarms due to fluctuations in water pressure.

B. Valve (Tamper) Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer.

C. Monitor Module: Addressable microelectronic module providing a system address for alarm initiating devices for wired applications with normally open contacts. Include address setting means on the module.

D. Control/Relay Module: Provide intelligent control relay modules. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

E. Fire Department Key Box: Provided by others.

2.10 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for smoke detectors, notification appliances, or other device requiring protection as indicated on the plans.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Factory finished to match the color of the protected appliance or device.

2.11 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Division 26.

B. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.

C. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.

D. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.

E. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.

F. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.

G. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket and red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.12 ACCESS TO EQUIPMENT

A. All detectors, modules, equipment, etc. shall be located so as to provide easy access for operation, service inspection and maintenance.

B. Access Doors:
   1. Provide access doors for all concealed equipment, except where above lay-in ceilings.
   2. Access doors shall be adequately sized for the devices served with a minimum size of 18" x 18", furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
   3. Access doors must be of the proper materials for type of construction where installed.
   4. The exact location of all access doors shall be verified with the Architect prior to installation.
   5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
   6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
      a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
      b. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
   7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
      a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
   8. Locking Devices: Flush, screwdriver-operated cam locks.
   9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
      a. Arrow United Industries.
      b. Bar-Co., Inc.
      c. J.L Industries.
      d. Karp Associates, Inc.
      e. Milcor Div. Inryco, Inc.
      f. Nystrom Building Products
      g. Wade
      h. Zurn

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall install, program and test all new equipment identified in this contract in accordance with the applicable codes, standards, and manufacturer’s instructions.

B. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.

C. The Contractor shall provide all required conduit and all associated hardware, and shall install (pull), connect, and test all cable for a complete fire alarm system. All wiring shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

3.02 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

C. Manual Fire alarm Boxes: Provide manual fire alarm boxes as shown on drawings. Mount manual fire alarm box on a background of a contrasting color. The operable part of manual fire alarm box shall be at 48 inches above floor level unless noted otherwise.

D. Smoke Detectors: Provide detectors as shown on drawings.
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke detector spacing.
   2. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   3. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
   4. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
   5. Install ceiling mounted detectors in areas with exposed structure tight to underside of floor/roof deck unless noted otherwise on drawings.

E. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, or valve-tamper switch that is not readily visible from normal viewing position.

F. Install ceiling mounted visible and audible/visible notification appliances in areas with exposed structure to bottom of floor/roof structure or at 30 ft AFF, whichever is lower.

G. Install ceiling mounted visible and audible/visible notification appliances in areas with finished ceilings flush with bottom of ceiling or at 30 ft AFF, whichever is lower.

H. Install wall mounted visible and audible/visible notification appliances with visible element (strobe) between 80 inches and 96 inches above finished floor unless noted otherwise on drawings.

I. Install wall mounted audible devices with the top of the device at least 90 inches above finished floor or 6 inches below the ceiling, whichever is lower, unless noted otherwise on Drawings. If combination devices are installed, they shall be installed per the visible signal device requirements.

3.04 PATHWAYS

A. Pathways shall be installed in conduit.

B. Minimum allowable conduit size shall be ¾ inch. The conduit shall be sized so that conduit fill does not exceed 75% of NFPA 70 maximum fill requirements. Cables in vertical risers shall not exceed 50% of NFPA 70 maximum fill requirements. Conduit installation shall be as required by the Contractor's layout and as described in these specifications. All conduit field routing shall be acceptable to the Owner. Routing not acceptable shall be rerouted and replaced without expense to the Owner.

C. All wire, cable, conduit and raceways shall be concealed in walls, ceiling spaces, electrical shafts or closets in finished areas except as specifically noted otherwise. Conduit and raceways may be exposed in unfinished areas or where specifically approved by the Owner.

D. Except as otherwise specified or indicated on the drawings, all conduit shall be installed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.

E. Conduit shall be located at least six inches from hot water or steam pipes, and from other hot surfaces. Conduit shall not block access to any existing equipment or fixtures.

F. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit for conventional hardwired class B initiating and notification appliance circuits.

G. Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit. The locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box. Conduit shall enter cabinets from the bottom and sides only.

3.05 CONNECTIONS

A. All wiring shall be terminated at devices or panels using terminal connectors for screw type terminals. All terminal connectors for conductors shall be pre-insulated ring type or pre-insulated spade type. Pre-insulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size. Pre-insulated terminal connectors shall include a metallic support sleeve bonded to the vinyl-insulating sleeve and designed to grip the conductor insulation.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled.

Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Provide equipment and connections to shutdown fan powered air distribution equipment with an individual capacity less than or equal to 2,000 cfm that are part of an air distribution system with a design capacity greater than 2,000 cfm.
2. Supervisory connections at valve supervisory switches.

3.06 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. All conduits and junction boxes shall be labeled as specified in Division 26 (red).

C. The location of end-of-line resistors shall be identified with a label indicating “EOL.”

D. Provide label at each initiating device indicating the device address. Label shall be visible from the floor below or immediately adjacent to the device.

3.08 GROUNDING

A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.09 FIELD QUALITY CONTROL

A. Systems shall be checked and tested in accordance with the instructions provided by the manufacturer to insure that the system functions as required and is free of grounds, opens, and shorts. Each device shall be tested.

1. Smoke detectors shall be tested with products of combustion.

B. Upon completion of the system installation and before the Date of Final Acceptance, a factory-trained technician shall perform all necessary tests and adjustments and shall then file a Letter of Certification and a Certificate of Completion (NFPA 72) with the Owner indicating that the system functions and conforms to the Fire Alarm System Specifications.

C. Upon completion of the system installation, a factory-trained technician shall perform all necessary tests and adjustments in the presence of the Owner’s designated personnel. Test in accordance with NFPA 72 and requirements of the authority having jurisdiction. Perform the following tests at a minimum:

1. Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion

Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    a. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
    b. Test visible appliances for the public operating mode according to manufacturer's written instructions.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire alarm system will be considered defective if it does not pass tests and inspections.

F. Include services of factory trained and certified technician to supervise installation, adjustments, final connections, and system testing as performed by the fire alarm contractor’s factory-trained technicians.

3.10 DEMONSTRATION

A. The equipment supplier's factory trained technician shall train the Owner's personnel in the proper use and maintenance of the system. Training sessions shall be conducted as needed, not to exceed a total of 2 sessions, with each session lasting a maximum of 4 hours each.

B. Demonstrate normal and abnormal modes of operation, and required responses to each.

END OF SECTION 284600

SECTION 311000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing.

B. Selective removal and trimming.

C. Debris removal.

1.02 SUMMARY

A. This Section specifies the construction of all labor, materials, equipment and services necessary to complete the site clearing and related items as indicated or specified herein or as indicated on the drawings.

B. Contractor shall provide all labor, materials, equipment, and services necessary to complete all site preparation work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to grading, removing, moistening, compacting, filling, cutting and protecting.

C. Site Investigation:
1. **Bidders are expected to visit the site to form their own conclusions as to the character of the site preparation and grading work.**
2. Verify survey data. Stake out all work and verify as to location and elevation. Carefully maintain all benchmarks, monuments, and other referenced points; if disturbed or destroyed, replace as directed.

D. All work shall be coordinated with other sections.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

B. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

C. Testing: As required by the latest industry codes and standards, and as shown on the Drawings and specified herein.

D. Tolerances shall conform to industry codes and standards, except as otherwise noted.

E. Clearing Firm Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.04 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

1.05 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

B. Sedimentation Barrier: See Section 015713 - Temporary Erosion and Sediment Control.

PART 3 EXECUTION

2.01 EXAMINATION

A. Comply with additional requirements specified in Section 017000 - Execution and Closeout Requirements.

2.02 PREPARATION

A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are to remain.

E. Install sedimentation barrier according to Section 015713 - Temporary Erosion and Sediment Control.

2.03 CLEARING AND GRUBBING

A. Clearing: Cut trees, stumps, shrubs, downed timber, and other vegetation for removal within identified area as indicated on drawings according to 29 CFR 1910.266. Follow recommendations of ANSI Z133 and best local practices for species involved.

B. Do not remove or damage vegetation beyond limits indicated on drawings.

C. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum subsoil disturbance.

2.04 SELECTIVE REMOVAL AND TRIMMING

A. Selective Removal: Individual tree and shrub identified for removal as indicated on drawings according to 29 CFR 1910.266.

B. Selective Trimming: Individual limbs and branches cut back according to ANSI A300 Part 1 identified for removal as indicated on drawings. Follow recommendations of ANSI Z133 and best local practices for species involved.

2.05 REMOVED VEGETATION PROCESSING

A. Do not burn, bury, landfill, or leave on-site, except as indicated on drawings.

B. Trees: Sell if marketable.

2.06 DEBRIS REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

PART 3 - NOT USED

END OF SECTION 311000

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SECTION 312200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading.

B. Fine grading.

1.02 SUMMARY

A. This Section specifies the construction of all labor, materials, equipment and services necessary to complete the site grading and related items as indicated or specified herein or as indicated on the drawings.

B. Contractor shall provide all labor, materials, equipment, and services necessary to complete all site grading work, as indicated on the Drawings, in accordance with local codes and standards, or as specified herein. This work shall include but not be limited to grading, removing, moistening, compacting, filling, cutting and protecting.

C. Site Investigation:
1. **Bidders are expected to visit the site to form their own conclusions as to the character of the site preparation and grading work.**
2. Verify survey data. Stake out all work and verify as to location and elevation. Carefully maintain all benchmarks, monuments, and other referenced points; if disturbed or destroyed, replace as directed.

D. Geotechnical Report:
1. Neither the Owner nor Architect guarantees the accuracy of the report nor the continuity of the soil conditions indicated at boring locations. Bidders are fully responsible for interpretations or conclusions they draw from the geotechnical report.

E. Finished Grade:
1. "Finished Grade" as used herein, refers to the required final grade elevation indicated. If the finished grades indicated by spot elevations conflict with those indicated by contours, the spot elevations will apply.
2. Unless otherwise indicated, give project site areas outside of building uniform slopes between points for which finished grades are indicated or between such points and existing established grade except provide vertical curves or roundings at abrupt changes in slopes.

1.03 RELATED REQUIREMENTS

A. Section 311000 - Site Clearing.

B. Section 312316 - Excavation.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with State of Project Site Location, Highway Department standards.

B. Installer Qualifications: Experience in performing work of this section, specializing in installation of work similar to that required for this project, employing workers who are skilled in this area of work, and whose projects have a record of successful in-service performance.

C. Certification: Product certificates signed by manufacturer, certifying materials comply with specified performance characteristics, criteria, and physical requirements.

D. Testing: As required by the latest industry codes and standards.
1. Provide testing as specified herein.

E. Tolerances shall conform to industry codes and standards, except as otherwise noted.

1.05 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey bench mark and intended elevations for grading areas are as indicated.

B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect above- and below-grade utilities to remain.

D. Notify utility company to remove and relocate utilities.
   1. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed as indicated on the drawings.
      a. Arrange with utility companies to shut off indicated utilities.
   2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
      a. Notify Architect not less than five days in advance of proposed utility interruptions.
      b. Do not proceed with utility interruptions without Architect's written permission.

E. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.

F. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.

G. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
   1. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
   2. Do not excavate within tree protection zones, unless otherwise indicated.
   3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.03 ROUGH GRADING

A. Excavate and fill subgrade material to elevations indicated on plans.

B. Replace displaced subgrade in accordance with Section 312323.

C. Remove and replace unsuitable materials as specified fill.

D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8", and compact each layer to a density equal to adjacent original ground.

3.04 FINE GRADING

A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.

3.05 SOIL REMOVAL

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.06 SUBGRADE

A. Prepare subgrade at all building areas to proper elevation to receive under-slab fill. Coordinate with Civil Drawings and / or Geotechnical Report as required.

B. Prepare subgrade at all paved areas to proper elevation to receive base course materials specified under another Section of these Specifications. Construct subgrade in fill layers not more than 8" in depth, each layer being thoroughly consolidated by soaking with water and rolling with a power roller having a weight of at least 250 pounds per inch width of tire.

C. Perform all grading required to bring the entire project area to the underside of the respective surfacing as determined by the finished grades.

3.07 COMPACTION

A. Compact as per geotechnical report or as noted below if not indicated.

B. Compaction of fills and foundation soils shall be in horizontal lifts not exceeding 8" in thickness. Compact to the percent of maximum density at optimum moisture content in accordance with ASTM D698, as follows:

Subgrade soil*	95%
Sub-base fill*	95%
Below footing elevation	95%
Above footing elevation	95%

C. *Compaction of soils shall be accomplished with a moisture content between optimum minus 3% and optimum plus 3%.

3.08 GRADING

A. After construction and final clean-up of exterior, and removal of all debris, grade building site to slopes and elevations directed. Leave graded areas raked smooth. Remove excess material from the site and legally dispose of.

3.09 PROTECTION

A. Protect all newly graded areas from traffic and erosion.

B. Keep areas free of trash and debris.

C. Repair and establish grades in any areas settled, rutted or eroded.

D. Protect and maintain benchmarks and survey control points from disturbance during construction.

E. Locate and clearly flag trees and vegetation to remain or to be relocated.

F. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.10 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, as required.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.11 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.

C. Leave site clean and raked, ready to receive work.

D. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

E. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 312200

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SECTION 313116
TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Site-applied termiticide for wood, steel, and concrete.

1.02 SUMMARY

A. All labor, materials, equipment and services necessary to complete all work involved in poisoning the soil below all slab-on-grade construction to provide a chemical barrier to protect the buildings and contents against attack by subterranean termites.

B. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide the quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

C. All areas of construction involving soil contact (such as removal of concrete or excavation around buildings) shall be treated with termiticide in accordance with these specifications and EPA requirements.

1.03 DEFINITIONS

A. EPA: Environmental Protection Agency

B. PCO: Pest control operator

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.

D. Soil Treatment Application Report - After application of termiticide is completed, submit report for Owner's record information, including the following:
   1. Date and Time of Application.
   2. Moisture content of soil before application.
   3. Brand name and manufacturer of termiticide.
   4. Quantity of undiluted termiticide used.

5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

E. Upon completion of soil poisoning, and as a condition of final acceptance, submit to the Owner a written guarantee providing that:
1. The application and formula was made at the concentration rates and methods in compliance with the EPA and the manufacturer's recommendations.
2. The effectiveness of the treatment is guaranteed for a term of five (5) years without any additional cost to the Owner.
3. Any evidence of subterranean termite activity and/or damage to the structure resulting from such activity within the guarantee period will be treated and/or repaired at no cost to the Owner.
4. The guarantee shall be fully transferable to other owners at no charge.

F. Manufacturer's Instructions: Indicate caution requirement.

G. Executed warranty.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:
1. Having minimum of three (3) years documented experience.
2. Licensed in the State in which the Project is located.
a. A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.

B. Materials: Provide certification that termiticide is EPA approved and conforms to requirements of authority having jurisdiction.

C. Regulatory Requirements: Conform to applicable requirements for application licensing and authority to use termite control chemicals

D. Chemical analysis tests shall be made of materials used on the basis of one test for each 10,000 SF of treated area. Samples and test may be taken of both concentrates and the dilute materials as being applied. See Section 01400 for provisions covering payment for testing.

E. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.07 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.08 MAINTENANCE SERVICES

A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard yearly (or other period) continuing service agreement, starting on the date of Certificate of Occupancy. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. General Warranty: The warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Warranty: Written warranty for five years from date of Certificate of Occupancy, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation

PART 2 PRODUCTS

2.01 SITE-APPLIED TERMITICIDE

A. Site Applied Termiticide for Wood, Steel and Concrete: Borate mineral salt based, spray applied termiticide formulated for use on wood, steel, concrete and other building materials.
   1. Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.
   2. Manufacturers:
      a. BASF Corporation; Termidor SC (Basis of Design)
      b. Bayer Corporation.
      c. Dow AgroSciences.
      d. FMC Corporation.
      e. Syngenta

f. AMVAC Chemical Corporation

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen and dry to absorb toxicant, ready to receive treatment.

B. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected.

C. Verify final grading is complete; see Section 312200.

D. Verify utility trenches are wide enough to receive application.

3.02 APPLICATION

A. Comply with manufacturer's written instructions.

3.03 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides are to be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

C. To avoid surface flow of the toxicant from the application site, treatment shall not be made when soil or fill is excessively wet. Apply only after all preparation for slab sub-base placement has been completed.

D. Concrete slab sub-base is native or engineered soil below the installed compacted granular base and vapor barrier (4" +/-) materials directly under the concrete.

E. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.04 INSTALLATION - SITE-APPLIED TERMITICIDE

A. Comply with manufacturer's written instructions.

B. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
   1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
   2. Foundations: Adjacent soil including soil along the entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating the slab, and around interior column footers, piers, and chimney bases; also along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
   3. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
   4. Masonry: Treat voids.
   5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

C. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

D. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

E. Post warning signs in areas of application.

F. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

G. Dispose of all containers and mixtures in accordance with manufacturer’s recommendations, Local, State, and Federal Regulations.

3.05 INSPECTION

A. Apply no material without 72 hour notification to the Owner Representative so he may be present during application.

B. Apply treatment material during normal working hours in order to be subject to inspection. Permit inspector to sample any and all material used, and to verify the rate of application and volumes.

3.06 PROTECTION

A. Do not permit soil grading over treated work.

B. Protect applications from damage after completion. Repair disturbances according to manufacturer's written instructions.

END OF SECTION 313116

SECTION 315000
EXCAVATION, SUPPORT AND PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes temporary excavation support and protection systems.

1.02 REFERENCE STANDARDS

A. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A328/A328M - Standard Specification for Steel Sheet Piling; 2024.

D. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

F. ASTM A690/A690M - Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments; 2024.

G. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

1.03 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
   1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shops Drawings and a comprehensive engineering analysis by a qualified professional engineer.

1.04 PROFESSIONAL CONDITIONS

A. Survey adjacent structures and improvements, employing a qualified professional engineer of land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M or ASTM A992/A992M.

C. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M or ASTM A690/A690M, with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4".

E. Cast-in-Place Concrete: ACI SPEC-301, of compressive strength required for application.

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

PART 3 – EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

C. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage or other evidence of movement to ensure that excavation support and protection systems remain stable.

D. Promptly repair damages to adjacent facilities cause by installing excavation support and protection systems.

3.02 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
   1. Remove excavation support and protection systems to a minimum depth of 48" below overlying construction and abandon remainder.

2. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

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SECTION 321216
ASPHALT PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes:
   1. Hot-mix asphalt paving
   2. Hot-mix patching
   3. Hot-mix overlay.

1.02 RELATED REQUIREMENTS

A. Section 024100 - Demolition for demolition and removal of existing asphalt pavement.

B. Section 311000 - Site Clearing for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

C. Section 321313 - Concrete Paving for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

1.03 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. Standard Specification for Emulsified Asphalt Nineteenth Edition; Revised Per Interim Specifications – Specifications – 1999 R(1998)
   2. Standard Specification for Viscosity Graded Asphalt Cement 19th Edition R(1996)
   3. Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures - Using Marshall Apparatus Nineteenth Edition; ASTM D1559-76

B. American Society for Testing and Materials (ASTM)
   1. D1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
   2. D2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
   3. D2171 Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer (RAP Asphalt Mixes)

C. Asphalt Institute (AI)
   1. MS-2 Mix Design Method for Asphalt Concrete and Other Hot Mix Types
   2. MS-22 Principles of Construction of Hot-Mix Asphalt Pavement, Addendum

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction and the DOT of the state in which Project is located.

B. Regulatory Requirements: Comply with applicable standards and requirements of the regulatory authority having jurisdiction and State DOT for asphalt paving work.

C. Asphalt-Paving Publication: Comply with Asphalt Institute Manual MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.05 PROJECT CONDITIONS

A. Environmental/Weather Limitations: Do not apply or produce asphalt materials if the underlying course is wet or excessively damp, the subgrade or base course is frozen, during rainy weather, or if the air temperature, measured in the shade away from artificial heat at the location of the paving operations, does not meet the following requirements:
   1. Tack Coat and Prime Coat: Minimum ambient temperature in the shade has been 40 deg F for at least 12 hours, immediately prior to application.
   2. Asphalt Base Course: Minimum surface temperature of 35 deg F and rising at time of placement.
   3. Asphalt Binder (Intermediate) Course: Minimum surface temperature of 40 deg F and rising at the time of placement; and,
   4. Asphalt Surface Course: Minimum surface temperature is above 50 deg F at time of placement for 1" lift or 40 deg F for all lifts greater than 1" in depth.

PART 2 – PRODUCTS

2.01 ASPHALT MATERIALS

A. Asphalt Cement – The type and grade of asphalt cement for the paving mixture shall comply with the applicable requirements of AASHTO Specification M226, Table 2, and meet governing DOT specifications.

B. Prime Coat - emulsified asphalt applications shall meet the requirements of AASHTO M140, and the governing DOT specifications.

C. Tack Coat - emulsified asphalt applications shall meet the requirements of AASHTO M140 and meet governing DOT specifications.

D. Hot Mix Asphalt – Unless otherwise noted on the drawings, the design mix shall have the minimum stability base on 50-blow Marshall Mix Design in accordance with AASHTO T245 or ASTM D1559.

E. Reclaimed Asphalt Pavement (RAP) – May be utilized as approved by the Owner. No more than 25% (total mixture) of RAP material shall be utilized in proposed mixes and shall meet the governing State Department of Transportation specifications. The origin of the RAP material shall be clearly identified to the Owner prior to approval, including the RAP percentage identified in the pavement mix design submittal. RAP material shall be free of contamination, including dirt, debris, concrete, clean stone, etc.

PART 3 – EXECUTION

3.01 COLD MILLING

A. Milling of existing asphalt pavement shall be at the depth and location as indicated on the Construction Drawings or as directed by the Owner.

B. The milled surface shall be reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust, and other objectionable material by the use of power brooms, power blowers, power vacuums or other means.

C. The Contractor shall coordinate the adjustment of manholes, meter boxes, drainage inlets, and valve boxes with the milling operation.

D. All milled material shall become the property of the Contractor and shall be disposed of off-site or used in conformance with Section 02300, Earthwork, or for utilization as Reclaimed Asphalt Pavement, in conformance with the specification provided above, as approved by the Owner.

3.02 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12" into adjacent sound pavement, unless otherwise indicated or directed by the Owner. Re-compact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 gal/sy.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix, and while it is still hot, compact flush with adjacent surface.

3.03 SURFACE PREPARATION

A. Proof-roll stone base in conformance with Article 3.06, Section 02300 Earthwork, immediately prior to paving.

B. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared substrate surface is ready to receive paving. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 gal./sy.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving; and,
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
   3. Adequate traffic control shall be provided to prohibit traffic from traversing applied area.

D. Prime Coat: Apply uniformly to non-asphalt surfaces when specified on the drawings at a rate of .20 gal/sy.

3.04 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

B. Spread mix at minimum temperature of 250 deg F and maximum temperature of 325 deg F.

C. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

D. Place paving in consecutive strips not less than 10'-0" wide unless infill or edge strips of a lesser width are required. Joint patterns shall be constructed parallel to traffic flow.

E. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.05 COMPACTION

A. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct lay-down and rolling operations to comply with requirements.

B. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density.

C. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

D. Protection: After final rolling, erect barricades to protect paving from traffic until pavement has cooled and hardened.

E. Density: Compare density of in-place material against laboratory specimen of same mixture, subjected to 50 blows of a Standard Marshall hammer on each side of specimen. Minimum acceptable density of in-place material shall be:
   1. Density: 95% of reference maximum theoretical density according to ASTM D2041 for binder (intermediate) and surface courses.
   2. Density: 92% of reference maximum theoretical density according to ASTM D2041 for base courses.

3.06 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base Course: ±1/4”.
   2. Binder (Intermediate) Course: ±1/4"; and,
   3. Surface Course: ± 1/8".

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10'-0" straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/2”.
   2. Binder (Intermediate) Course: 1/4"; and,
   3. Surface Course: 1/8".

C. Contractor’s duties relating to testing include:
   1. Notify Owner 72 hours prior to asphalt paving.
   2. Notifying laboratory of conditions requiring testing; and,
   3. Coordinate with laboratory for field testing.

3.07 DISPOSAL

A. Except for material indicated to be recycled, remove excavated or milled materials from Project site and legally dispose of them in an EPA-approved landfill.

3.08 QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests, inspections, and to prepare test reports. Testing agency shall be paid by the Owner.

B. The Owner shall pay for and have testing agency take two 4" diameter cores per 5,000 sq. yds. of intermediate course, at locations selected by Owner, for thickness tests. Contractor shall repair holes resulting from coring to match existing paving. The Owner reserves the right to take additional testing and should these tests show insufficient thickness, all areas shall be remediated as prescribed by the Owner.

C. The Owner shall provide on-site nuclear density testing at random locations during paving operations for all proposed asphalt courses.

D. The Contractor may be required to remove and replace hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements, at not cost to the Owner.

E. Cleaning of asphalt paving equipment and tools is not permitted on site.

END OF SECTION 321216

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SECTION 321218
ASPHALT SEAL COAT

PART 1 – GENERAL

1.01 SUMMARY

A. Work under this section shall include:
   1. Repairing pavement cracks
   2. Cleaning and preparing the pavement surface
   3. Mixing the pavement sealer
   4. Applying the asphalt pavement sealer over existing bituminous pavement surfaces.

1.02 REFERENCED SECTIONS

A. Section 321223 - Imprinted Asphalt.

1.03 REFERENCE STANDARDS

A. American Society of Testing Materials (ASTM)
   1. Standard Practice for Sampling of Bituminous Materials
   2. Asphalt Used in Damp-proofing and Waterproofing, Type II and III
   3. Standard Test Methods Emulsion Bitumen's Use as Protective Coatings
   4. Joint Sealant Hot-Applied for Concrete and Asphalt Pavement
   5. Emulsified Coal Tar Pitch (Mineral Colloid Type)
   6. Design, Testing and Construction of Slurry Seal
   7. The following ASTM test methods: D140, D466, D529, D244, C88, C131, C117, C127, C123, D1310, D2170, D95, D402, D2171, D5, D113, D2042, D711, D969, D1475, D3960, D2486, E70, D562, D3583, D3236, D5249, D6690, B117, D977

B. Federal Specifications for Waterborne Traffic and Airfield Marking Paints
   1. TT-P-1952E Types I, II, and III
   2. TT-P-1952D
   3. TT-P-1952B

1.04 PROJECT / SITE CONDITIONS

A. Ambient Conditions
   1. Both surface and ambient temperature must be a minimum of 50°F and rising before applying cold applied crack fillers, oil spot primers, pavement sealers or traffic paints (materials). Ambient and surface temperature shall not drop below 50°F for a 24 hour period following application of materials.
   2. Apply materials during dry conditions when rain is not imminent or forecast for at least 24 hours after application.

B. Pavement/Surface Conditions
   1. Newly placed (paved) asphalt pavement surfaces should be allowed to cure a minimum of four (4) weeks under ideal weather conditions (70°F) before applying coatings.
   2. New pavement surfaces shall be free of residual oils or chemicals associated with the placement of new asphalt pavement.
   3. Aged pavement surfaces shall be cleaned and prepared as recommended in this specification under PART 3 of this specification.

PART 2 – PRODUCTS

2.01 MATERIALS

A. SealMaster Polymer Modified Coal Tar Sealer (PMCTS) at the following specifications:
   1. SealMaster Specification
      a. Material – Material shall be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
      b. Non Volatiles – 40%
      c. Ash Non Volatiles – 35 – 40%
      d. Solubility of Non Volatiles in CS2% - 20 min.
      e. Specific Gravity 25C – 1.18 MIN.
      f. Drying Time – 8 hr. MAX. (Typically less than 60 min.)
      g. Adhesion & Resistance to Water – No Penetration or Loss of Adhesion
      h. Resistance to Heat – No Blistering or Sagging
      i. Flexibility – No Cracking or Flaking
      j. Resistance to Impact – No Chipping, Flaking or Cracking
      k. Resistance to Volatilization – 10% Loss in Weight Max.
      l. Wet Film Continuity – Smooth, Nongranular Free from course particles

B. SealMaster Polymer Modified MasterSeal (PMM) to be used in AK, CA, AZ and NM ONLY at the following specifications:
   1. SealMaster Specification
      a. Material – Material shall be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
      b. Non-Volatile, 43 – 47%
      c. Ash of Non-Volatile, 42 – 52%
      d. Specific Gravity 25oc 1.15 – 1.25
      e. Drying Time – 8hrs. MAX.
      f. Adhesion & Resistance to Water – No Penetration or Loss of Adhesion
      g. Resistance to Heat – No Blistering or Sagging
      h. Flexibility – No Cracking or Flaking
      i. Resistance to Impact – No Chipping, Flaking or Cracking
         1) Note: Only materials meeting the above specifications will be accepted. Certificate of Compliance from the refined coal tar manufacturer is required prior to application.

C. Oil Spot Treatment: SealMaster PetroSeal or prep seal oil spot primer as specified by the manufacturer for pavement sealer.

D. Water

E. Aggregate or sand as required and specified by the manufacturer

F. Polymer Additive (optional)

G. Fortifier
   1. Water based epoxy-latex additive, designed as a fortifier for refined coal tar emulsions to increase resistance to power steering marks, fuel and chemical effects to assist in fast drying of the coating is acceptable.
   2. Thickeners only are not permitted.

2.02 EQUIPMENT

A. Self-propelled squeegee equipment shall have a least 2 squeegee or brush devices (one behind the other) to assure adequate distribution and penetration of sealer into the bituminous pavement. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.

B. Pressurized spray application equipment shall be capable of spraying pavement sealer with sand added. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.

C. Hand squeegee and brushes shall be acceptable only in areas where practicality prohibits the use of mechanized equipment.

2.03 MIX DESIGNS

A. Sealer concentrate – 100 Gallon

B. Silica Sand 400 Meeting 40 to 60 fineness rating (AFS).
   1. Black Beauty Slag Sand (w/ comparable sieve rating) may be substituted when silica sand is not available.

C. Water – Specified material does not require onsite dilution

D. Fortifier 3%

E. Curing agents on high traffic areas (when applicable).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Apply pavement sealer when ambient temperature is 50 deg F and rising for a period of 24 hours after application. Do not apply when temperature is expected to drop below 50 deg F in a 24-hour period. Do not apply if rain is imminent within 8 hours.

B. Do not apply pavement sealer when ambient temperature is 90 deg F and above without first cooling the surface with a fine mist of water (fogging). The fogging should only dampen the surface without causing puddling.

C. Between September 15 and May 1, check the specifications and requirements of the State Department of Transportation WEATHER LIMITATIONS on the permitted dates of applying the seal coats.

3.02 SURFACE PREPARATION

A. Surface must be free from dirt, dust and includes grass along the edges. Remove and dispose of any loose and unsuitable materials, dirt, and debris from pavement surface by power blower or mechanical sweeping equipment.

B. Surface hairline cracks up to 1/2" must be filled with crack filler; cracks larger than 1/2" must be cleaned and filled with elastomeric emulsion crack filler.

C. When using a high performance crack sealant, please note on your proposal.

D. Potholes, alligator areas, and similar surface defects must be cut out and repairs made.

E. Treat all grease, oil and gasoline spots with compatible primer of the manufactured coating. In hot weather, the surface should be fogged with water prior to sealing.

F. Prior to spreading pavement sealer, paint all existing white paint stripes with black paint.

G. Contractor to dispose of all cans, bags and leftover materials off-site.

3.03 APPLICATION

A. Mix pavement sealer in accordance with the manufacturer’s procedure to a uniform consistency before using. For each coat, the sealant shall be diluted with clean potable water while agitating. The percent of water to be added will be as per the manufacturer specification based on the asphalt surface quality, and the type of traffic it will experience. When the rubberized mixture has thickened, add sand or aggregate slowly to the mixing tank. Mix thoroughly before and slowly during the application.

1. First coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time are total coats to exceed 0.51 gallons per square yard. The first coat may be applied by hand squeegee, self propelled squeegee equipment or pressurized spray equipment. Hand Squeegee or self propelled squeegee equipment is preferred.

2. Second coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time are total coats to exceed 0.51 gallons per square yard. The second coat must be applied with pressurized spray equipment.

B. Allow a minimum of 24 hours of curing time before allowing traffic over treated surface or application of traffic marking paint. Use of solvent borne paint shall not be permitted.

C. Lines, stencils, and markings shall be repainted in original size & location, unless otherwise directed by the Owner.

D. It is the Contractor's responsibility to check local zoning codes & regulations.

E. All seal coat and re-striping projects must be performed during available time periods (usually at night) that DO NOT interfere with normal store operations. Applications must be staged to provide customers free access to Sprouts the following business day.

END OF SECTION 321218

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SECTION 321223
IMPRINTED ASPHALT

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes specifications for proposed temporary and permanent pavement markings, including pavement marking removal.

1.02 PROJECT CONDITIONS

A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 50 deg F not exceeding 90 deg F and relative humidity at a maximum of 85%.

B. Surface Preparation: The surface shall be clean and free of dirt, grease, oil, or other contaminants which could interfere with adhesion.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Temporary and Permanent Pavement-Marking Paint:
   1. Sherwin Williams Setfast Non- leaded Chlorinated Rubber - White on asphalt (TM5126), yellow on concrete (TM5127), or as indicated on the drawing(s) is preferred.
   2. Sherwin Williams “Setfast Acrylic Waterborne Traffic Marking Paint” – White on asphalt (TM2160), yellow on concrete (TM2161), or as indicated on the drawing(s).
   3. Valspar Enterprise Latex Traffic Marking Paint – White on asphalt (#2540), yellow on concrete (#2541), or as indicated on the drawing(s).
   4. PPG (Pittsburgh Paints) “SPEEDHIDE® Traffic and Zone Marking Flat Latex” – White on asphalt (11-23), yellow on concrete, or as indicated on the drawing(s).

PART 3 – EXECUTION

3.01 PERMANENT PAVEMENT MARKINGS

A. Allow new asphalt paving to age a minimum of 48 hours before painting. New concrete pavement shall age a minimum of 30 days before painting, unless otherwise approved by the Owner.

B. Sweep and clean surface to eliminate loose material and dust prior to application.

C. Apply paint material at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils and dry film thickness of 7.5 mils (each coat).

D. Paint shall be applied in 2 coats to a clean, dry surface using template or a striping machine. Stripes shall be of uniform width of 4" wide, unless otherwise noted on the drawing(s). Other markings shall be provided as on the construction drawings.

3.02 TEMPORARY PAVEMENT MARKINGS

A. Temporary paint shall be applied in accordance with permanent pavement marking specifications. However, only 1 coat of paint shall be required to a clean, dry surface using template or a striping machine. The Contractor may also propose to utilize temporary/removable pavement marking tape, as approved by the Owner.

B. Markings shall be applied using butyl adhesive pads or paint to clean dry pavement surfaces which are free of cracking, checking, spalling, or failure of underlying base material.

C. When required, removable marking tape or pavement marking paint shall be applied on clean dry surfaces at designated locations. Tape that has become damaged and is no longer serviceable shall be replaced without additional compensation.

D. All temporary markings and striping shall be removed when no longer required. Any pavement area that has been determined to be damaged as a result of the removal operation shall be repaired at no cost to the Owner.

3.03 PAVEMENT MARKING REMOVAL

A. Existing pavement marking lines and symbols shall be removed as to not materially or structurally damage the surface or texture of the pavement. A motorized abrasive device shall be utilized to remove existing markings. The Contractor shall repair any damage to the pavement at no expense to the Owner. The pavement surface shall be left in a condition that will not mislead or misdirect customers or motorists. Pavement marking removal within public rights of way shall be completed in accordance with the regulatory authority having jurisdiction and the specifications.

END OF SECTION 321223

SECTION 321313
CONCRETE PAVING

PART 1 GENERAL

1.01 Section Includes all portland concrete pavement outside the building limits, including but not limited to:

A. Concrete sidewalks, integral curbs, gutters, median barriers, parking areas, and roads.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete. (For concrete located within the building limits)

1.03 REFERENCE STANDARDS

A. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

C. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

D. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; Current Edition.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

I. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2024.

J. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; 2023.

K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

L. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

M. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

N. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.

O. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

P. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

Q. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2024.

R. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

S. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).

T. ASTM D5249 - Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints; Current Edition.

U. ASTM D5893/D5893M - Standard Specification for Cold-Applied, Single-Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements; Current Edition.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301R-99 and ACI330R-92, unless modified by the requirements of the Contract Documents.

C. The owner shall provide and pay for testing services. A slump test and air test shall be performed for each load delivered. Four standard test cylinders shall be taken for each 55 cubic yards of concrete or each days pour, whichever is more frequent. Two cylinders shall be broken at 7 days and two cylinders shall be broken at 28 days.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. The type of steel reinforcement shall be as shown on the drawings.
   1. Plain-Steel Welded Wire Fabric: ASTM A1064/A1064M, 6" x 6" #10 mesh fabricated from steel wire into flat sheets.
   2. Reinforcement Bars: ASTM A615/A615M, Grade 40, deformed;
   3. Plain Steel Wire: ASTM A82, as drawn; and,

4. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening steel reinforcement. Manufacture bar supports according to CRSI's Manual of Standard Practice.
5. Diamond Dowels: 1/4” x 4-1/2” Diamond Dowels by PNA.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Normal - Type I , IIPortland cement, gray color.

B. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
1. Combined aggregate gradation for concrete pavement and other designated concrete shall be 8% - 18% for large top size aggregates (1-1/2”) or 8% - 22% for smaller top size aggregates (1” or 3/4”) retained on each sieve below the top size and above the No. 100 sieve. Concrete pavements shall have a maximum aggregate size of 1-1/2”.

C. Fly Ash: The use of fly ash, slag and bottom ash is prohibited.

D. Water: Clean, and not detrimental to concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A;

E. Admixtures: Certified by manufacturer to contain not more than 0.1 % water-soluble chloride ions by mass of cement and to be compatible with other admixtures, as follows:
1. Air-Entraining Admixture: ASTM C260/C260M;
2. Water-Reducing and High-Range Admixture: ASTM C494/C494M, Type F;
3. Water-Reducing and Accelerating Admixture: ASTM C494/C494M , Type E; and,
4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

F. Calcium Chloride: The use of calcium chloride or admixtures containing more than 0.05% chloride ions is prohibited.

G. Curing Materials:
1. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry;
2. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
3. Water: Potable.
4. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
5. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.
6. Clear Waterborne Membrane-Forming Curing Compound: ASTM C309 STM C309, Type 1, Class B.
7. White Waterborne Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B.

2.03 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Concrete Properties:
   1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 4,000 psi.
   2. Slump Limit: maximum of 5" at time of placement for pavement, 2" maximum for curb and sidewalk.
   3. Air Content: 5% to 8% for pavement, curb and sidewalk.

D. Coloring Agent: When required, add coloring agent to mix according to manufacturer's written instructions.
   1. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork; and,
   2. Coloring Agent: ASTM C979/C979M, synthetic mineral-oxide pigments, or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

E. Ready-Mixed Concrete: Comply with requirements and with ASTM C94/C94M and ASTM C1116/C1116M.

2.04 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. On-site mixing must be approved by the Owner. Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M . Mix concrete materials in appropriate drum-type batch machine mixer.

2.05 JOINTS, FILLERS, AND SEALANTS

A. Joint-Sealant Backer Materials: ASTM D5249, Non-Staining, compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. Joint Sealant: Non-priming, pourable self-leveling silicone sealant for concrete and asphalt.
   1. Cold-Applied Joint Sealant ASTM D5893/D5893M, self leveling silicone sealant. Crafco Inc. “Roadwaver Silicone-SL”; Dow Corning “888, or 890-SL”; Sonneborn “Sonomeric 1 Sealant”; Tremco “Vulkem 45”; and,
   2. Hot-Applied Joint Sealant: ASTM D3405, Polymeric sealant. Crafco Inc. “ROADSAVER 22”; W.R. Meadows, Inc. “SEALTIGHT HI-SPEC”.

C. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D1751, asphalt-saturated cellulosic fiber, ASSHTO M 153, Type I: or ASTM D1752, cork or self-expanding cork.

D. Exterior Concrete Sealant: Sonneborn “Kure-N-Seal 30” exterior acrylic sealer, or Euclid “Super Rez-Seal”.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. Surface Preparation: Proofroll prepared subbase, per Section 312000 - Site Clearing.

3.03 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

3.04 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations.
   1. Maintain sufficient quantity of forms to allow continuance of work so that forms remain in place a minimum of 24 hours after concrete placement.
   2. Forms shall be cleaned and casted with form release agent thoroughly after each use and before concrete is placed; and,
   3. Flexible or curved forms shall be used on curves. Forms shall be of full depth of the concrete and of a strength when staked, sufficient to resist the presence of the concrete and the loads resulting from the finish operations without springing, setting or losing their shape.

3.05 REINFORCEMENT

A. Accurately position and support reinforcement, and secure against displacement. Set wire ties with ends directly into concrete.
   1. Install welded wire fabric in lengths as long as practicable; lap at least one full mesh, and lace splices with wire; and,
   2. Support reinforcing steel on wire chairs to ensure that wire stays mid-depth of sidewalk section during concrete pour.

3.06 PLACING CONCRETE

A. Coordinate installation of snow melting components.

B. Place concrete in accordance with ACI PRC-304.
   1. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping according to recommendations in ACI 309R.
   2. Screed and initial-float concrete surfaces with darby or bull float before excess moisture or bleed water appears on the surface.
   3. Protect concrete from cold or hot weather during mixing, placing, and curing; and,
   4. All concrete walks and aprons shall be a minimum of 4" thick as shown on the drawings, with a turned down edge as detailed.

C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

3.07 JOINTS

A. Construct pre-molded expansion and contraction joints, tied construction joints, control joints, thickened edge expansion joints, isolation joints, and construction joints, straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline unless otherwise detailed.
   1. Expansion joints and Contraction joints: Pre-molded as indicated on the drawings.
      a. Provide joint filler for the entire depth of the slab section and not less than 1" below finished surface so as to allow for joint sealer.
      b. Provide thickened edge expansion joint as indicated on the drawings.
      c. Water-Reducing Admixture: ASTM C494/C494M, Type A;
      d. Provide 1/2" expansion joints for curb and gutter and sidewalk at 100'-0" on center.
   2. Tied construction joints: As indicated on drawings.
   3. Control joints: Depth shall be equal to 1/4 of the concrete thickness or 1", whichever is deeper. For sidewalks, control joint spacing shall be equal to the sidewalk width. For concrete pavement, control joint spacing shall be placed as shown on the drawings, no greater than 30 times the slab thickness on center either way.
      a. Form tooled joints in fresh concrete by grooving top portion with recommended tool and finishing edges with jointer.
      b. Form sawed joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete within 24 hours of the concrete placement and as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.

3.08 Evaporation Retarder: Apply to concrete surfaces if hot, dry, or windy conditions exist. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

3.09 Pavement Tolerances: Comply with tolerances in ACI 330.1, Specification for Plain Concrete Parking Lots.

3.10 FINISHING

A. All exterior concrete shall receive a medium broom finish.

B. Curing: Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Cure concrete by one or a combination of the following methods:
   1. Moisture cure concrete by water, continuous fog spray, continuously wet absorptive cover, or by moisture-retaining-cover curing. Keep surfaces continuously moist for not less than 7 days
   2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

C. All exterior concrete surface shall receive one coat of exterior sealer.

3.11 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

C. Protect concrete from damage. Provide adequate traffic control to prevent traffic from pavement for at least 14 days after placement.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than 2 days before date scheduled for substantial completion inspections.

E. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION 321313

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SECTION 321723
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. "Click and Collect" Painted pavement marking stencil.

1.02 ENVIRONMENTAL REQUIREMENTS

A. Minimize dust emissions and provide equipment that suppresses dust.

1.03 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize Temporary Controls specified in Section 015000 as required.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pavement Stencil Co., PO Box 18034, Roanoke, VA 24014; Toll Free Tel: 800-250-5547;; Email: stencils@pavementstencil.com ; Web: www.pavementstencil.com
   1. Substitutions: Not permitted.

2.02 PRODUCT

A. Pavement Stencil
   1. Sprouts Farmers Market C&C Parking Stencil (“Pick Up”)
      a. Website: www.stencilfast.com/products/sprouts-carside-pickup-3-layer-stencil
   2. Traffic and Zone Marking Paint:
      a. Manufacturer: RAE Products and Chemicals Corporation
      b. Supplier: Grainger, Phone: 1-800-GRAINGER, website: www.grainger.com
      c. Color: 5192 Green / Verde or 4970 White / Blanco

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that pavement is dry and ready for installation.

B. Notify Architect of unsatisfactory conditions before proceeding.

C. Examine surfaces and adjacent areas where products will be applied and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.

D. Beginning of application indicates acceptance of substrate conditions.

3.02 PREPARATION

A. Establish survey control points for locating and dimensioning of markings.

B. Clean surfaces prior to installation.
   1. Remove dust, dirt, and other debris.

C. Where existing pavement markings are indicated on Construction Drawings to be removed or would interfere with adhesion of new paint, sodium bicarbonate (soda) blasting shall be used to remove the markings. Equipment employed shall not damage existing paving or create surfaces hazardous to vehicle or pedestrian traffic and shall be equipped with a manufacturer’s recommended mist system for dust suppression.

3.03 INSTALLATION

A. General:
   1. Position pavement markings as indicated on drawings.
   2. Field location adjustments require approval of Architect.
   3. Install parking stall striping and emblems according to manufacturer's recommended procedures for the specified material.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field inspection for deviations from true alignment or material irregularities.

C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

3.05 PROTECTION

A. Prevent approaching traffic from crossing newly applied pavement markings.

B. Replace damaged or removed markings at no additional cost to Owner.

C. Preserve survey control points until pavement marking acceptance.

END OF SECTION 321723

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SECTION 321726
TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polymer concrete tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 SUMMARY

A. Contractor shall provide all labor, materials, equipment and services necessary to complete all work including but not limited to delivering, furnishing and installing polymer concrete tiles and anchors as indicated on the drawings, in accordance with manufacturer's instruction, and as specified herein.

B. Furnish and install all polymer tiles in accordance with ADAAG (Americans with Disabilities Act Accessibility Guidelines) Sections 4.1, 4.7.7, and 4.29.2, and local building code requirements.

C. All work shall be coordinated with other sections.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

C. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2024.

D. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.

E. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

F. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.

G. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.

H. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).

I. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.

J. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.

K. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

L. ATBCB PROWAG - Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, standard details, details specific to this project, written installation, and maintenance instructions.

C. Test Reports: Compressive strength, tensile strength, slip resistance, wear resistance of polymer tiles.

D. Executed warranty.

E. Provide spare pavers to Owner as required in Section 017700, Closeout Procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
   1. All tiles shall come from the same batch.
   2. All units shall be sound and free from defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.

B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.
   1. Demonstrate not less than five (5) years experience in successful installation of polymer tiles systems similar to the work and quantity of tiles required for the project.

C. Manufacturer’s instructions for installation shall be delivered and stored with the materials.

D. EZ-Set composite concrete tiles incorporating truncated domes shall conform to the following:
   1. Compressive Strength of tile: 16,000 psi (ASTM C109/C109M).
   2. Tensile Strength of tile: 2083 psi (ASTM D638).
   3. Flexural Strength of tile: 2,300 psi (ASTM D790).
   4. Slip Resistance Wet / Dry: .79.
   5. Wear Resistance (ASTM D2486) 5000 Cycles – No Wear.
   6. Impact Resistance (ASTM D2794) 60” pounds – 1/4” indentation – no visible cracking.
   7. Water Absorption (ASTM D570):
      a. Average % Absorption 2 hour: 0.0
      b. Average % Absorption 24 hour: 0.0
   8. Freeze / Thaw Cycling (ASTM D1037) 5 cycles - No degradation or appearance change.
   9. Salt Spray (ASTM B117) 200 hours – No visible degradation, including spalling, cracking or pitting. Slight spotting.

10. Chemical & Stain Resistance (ASTM D543 / ASTM D1308) 54 chemical, commercial and consumer products tested. Range: No effect to severe staining. List of products available.
11. Shear Bond Strength of panel 500-550 psi.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.

B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.07 FIELD CONDITIONS

A. Drainage: Minimum slope for paving areas are as noted on the Drawings.

B. Do not install tiles during rainy or snowy conditions.

C. Do not install tiles over frozen base materials.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: Two (2) years for materials and installation, commencing on Date of Substantial Completion.

D. Installation Contractor shall perform installation warranty work during the two (2) year warranty period as required by Owner, at no extra cost to the Owner. This work includes:
1. Replacement of broken or damaged tiles.
2. Reinstallation of uneven tiles.

E. Manufacturer Warranty: Provide standard 5-year warranty against manufacturing defects, breakage, or deformation of plastic tiles. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Polymer Concrete Tactile and Detectable Warning Surface Tiles:
1. Detectable Warning Systems, Inc, 8081 Phillips Highway, Suite 22, Jacksonville, FL 32256, Tel.: (866) 999-7452, www.detectable-warning.com.

2. Detectable Warning Tactile Panels manufactured by Masons Supply Company 2637 SE 12th Ave., Portland, Oregon 97202. Telephone (503) 234-4321, www.masco.net

2.02 MATERIALS

A. Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory-applied removable protective sheeting.

B. Basis of Design: Alertcast replacable cast-in-place composite polymer panels specified are based on composite tiles manufactured / distributed by Detectable Warning Systems, Inc.
1. Pattern: In-line pattern of truncated domes complying with ADA Standards.
2. Color: Color shall be homogenous throughout the mat. Colors must provide light-on-dark or dark-on-light contrast with the surrounding substrate / surface. Yellow conforming to Federal Color No. 33538, Color shall be homogenous throughout the panel.
3. Size: 24” x 36”.

C. CASTinTACT concrete warning panels by Masons Supply Company.

2.03 CONCRETE BASE

A. Provide reinforced concrete slab under pavers and sand leveling course as specified herein, per section 033000, and as indicated on the drawings.

2.04 ACCESSORIES

A. DWS Stainless Steel replaceable concrete anchors.

PART 3 EXECUTION

3.01 EXAMINATION

A. When installation location is near site boundary or property line, verify required location using property survey.

B. Verify that work area is ready to receive work:
1. If existing conditions are not as required to properly complete the work of this section, notify Architect.
2. Do not proceed with installation until deficiencies in existing conditions have been corrected.

C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

D. Verify that subgrade preparation, compacted density, and elevations conform to the manufacturer's recommendations for polymer tiles prior to commencement of work. Verify that adjacent vertical surfaces (walls), edge restraints, and concrete paving have been installed defining limits of the polymer tiles.

E. Using barricades, cones or other means, block off work area to pedestrian and vehicle traffic during installation process. Be certain that safety guidelines are followed according to government or other standards.

F. Inspect newly poured concrete to make sure it is wet, uniform, even and ready to support polymer tiles. Inspect tiles to ensure they are clean and free of foreign materials and defects before installation.

G. Notify Owner's Representative and Architect of conflicts discovered on the site or prior work done by others, which would prevent proper installation of polymer tiles.

3.02 PREPARATION

A. Ensure reinforced concrete slab is installed in required thickness for hardscape/sidewalk area or vehicular traffic.
   1. Hardscape/Sidewalk Areas (pedestrian traffic): Requires 4" reinforced concrete slab under sand base course.
   2. Vehicular traffic (parking lots): Requires 6" reinforced concrete slab under sand base course.

B. Trace an outline where tiles are to be placed in the wet concrete. This can be done using the point of a trowel. Be certain that the placement meets the specifications and drawings for this job.

3.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions and per ADAAG requirements.
   1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
   2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.

B. Coordinate installation of polymer tiles with installation of adjacent work including but not limited to asphalt pavement, concrete pavement, curbs, sidewalks, landscape work and lighting.

C. Layout: Lay the tiles in the pattern as indicated.
   1. In addition to the regular mason's tools which will be used to finish the ramp surface, installation of the Alertcast tiles can be assisted with a rubber mallet and a 4'-0" level with electronic slope readout.
   2. If applicable, use standard square and edge units supplied by manufacturer for edges.
   3. Do not use units cut smaller than one third of a whole polymer tile along edges subject to vehicular traffic.
   4. Minimize installation of pieces smaller than one-quarter full size of paver unit.

D. Install tiles plumb, level, and true to line and grade.

1. Set tiles, being careful not to disturb newly poured concrete.
2. Maintain the slump range between 4 & 6. Check the slope using the electronic level to be certain that it meets the required standards.
3. Insert anchor bolts into holes on the tiles and screw on the receiver portion of the anchor on the other side. Tighten securely by holding anchor in place and hand tightening receiver.
4. Place tiles carefully by hand, maintaining accurate alignment and uniform top surface. Set first tile in place at one end of the traced outline and press into the wet concrete using a wiggling motion. Be careful not to push the tiles too far into the concrete. The edge of the tile should be even and level with the surrounding concrete. Place the second tile next to the first, leaving a 1/2" gap and using the same wiggling motion, press it into the wet concrete. Be certain that the second tile is even and level with the first and with the surrounding concrete.

E. Cutting: Cut tiles with sharp knife to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

F. Trowel finish concrete flat, remove any excess concrete and leave a 1/2" gap between the tiles. Apply broom finish or other recommended finish to the area immediately surrounding the tiles.

G. Recheck the slope using the electronic level, and adjust the tiles if necessary to maintain the required slope specifications.

H. The final step of the process is to sponge, or brush the surface to remove any excess concrete that may have been left on the surface of the tiles.

I. Field Adjustment:
1. Locate relative to curb line in accordance with ATBCB PROWAG, Sections 304 and 305.
2. Orient so dome pattern is aligned with the direction of ramp.

J. Install units fully seated to substrate, square to straight edges and flat to required slope.

K. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

3.04 TOLERANCES

A. Check final elevations of tiles for conformance to the drawings and ADAAG requirements.

B. Tolerances: Do not exceed 1/16" unit-to-unit offset from flush (lippage) or 1/8" in 24" and 1/4" in 10'-0" from level, or indicated slope, for finished surface of paving.

3.05 CLEANING UNITS

A. Remove excess sealant or adhesive from joints and edges.

B. Clean four days prior to date of scheduled inspection.

3.06 PROTECTION

A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.

B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

C. Protect tiles against damage from rolling loads following installation by covering with plywood.

D. Clean tiles by methods specified by the manufacturer.

END OF SECTION 321726

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SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Wire fabric.

C. Concrete.

D. Manual gates with related hardware.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

F. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

G. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

H. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

I. ASTM F626 - Standard Specification for Fence Fittings; Current Edition.

J. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates; Current Edition.

K. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).

L. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).

M. CLFMI CLF 2445 - Product Manual - Drawings; 2012.

N. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.

O. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2023.

P. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

C. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE 7:
   1. Design Wind Load: As indicated on Drawings.
      a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.02 COMPONENTS

A. Line Posts: 2.875 inch diameter.

B. Corner and Terminal Posts: 2.38 inch diameter.

C. Fabric: 2 inch diamond mesh interwoven wire, 9 gauge, 0.1483 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
   1. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI CLF 2445 / CLFMI Product Manual" and requirements indicated below.

D. Tension Wire: 6 gauge, 0.1920 inch thick steel, single strand.

E. Tie Wire: Aluminum alloy steel wire.

2.03 MATERIALS

A. Posts, Rails, and Frames:
   1. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating complying with ASTM F1043 and ASTM F1083.
      a. Type A zinc coating in accordance with CLFMI Product Manual.
   2. Line Posts: Type I round in accordance with FS RR-F-191/1D.
   3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
   4. Height: As indicated on the Drawings.

B. Wire Fabric:
   1. ASTM A392 zinc coated steel chain link fabric.
   2. Height: As indicated on the Drawings.

C. Concrete:
   1. Type specified in Section 033000.

2.04 Manual Gates and Related Hardware

A. General: ASTM F900 for gate posts and single or double swing gate types.
   1. Gate Leaf Width: As indicated on Drawings.
   2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.

B. Pipe and Tubing:
   1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; manufacturer's standard protective coating and finish.
   2. Aluminum: ASTM B429/B429M; manufacturer's standard finish.

C. Frame Corner Construction: Welded or assembled with corner fittings.

D. Hardware:

1. Hinges: 180-degree outward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.
4. Padlock and Chain: Owner provided.

E. Closer: Manufacturer's standard.

2.05 FITTINGS

A. Provide fittings according to ASTM F626 .
1. Provide corner arms at fence corner posts unless extended posts are indicated.

B. Finish:
1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of zinc.

2.06 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.07 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 PREPARATION

A. Removal: Obstructions or debris.

B. Stake locations of fence lines, gates, and terminal posts. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.02 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Install chain-link fencing according to CLFMI Product Manual and ASTM F567 and more stringent requirements specified.

C. Place fabric on outside of posts and rails.

D. Line Post Footing Depth Below Finish Grade: ASTM F567.

E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

F. Post Setting: Set posts with mechanical anchors at indicated spacing.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

G. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

H. Line Posts: Space line posts uniformly at 96 inches (2440 mm) o.c.

I. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
   1. Extended along top and bottom of fence fabric.

J. Do not stretch fabric until concrete foundation has cured 28 days.

K. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch (50-mm) bottom clearance maximum between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

3.03 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Do not infringe on adjacent property lines.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.

C. Post Settings: Randomly inspect three locations against design for:
1. Hole diameter.
2. Hole depth.
3. Hole spacing.

D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.

E. Gates: Inspect for level, plumb, and alignment.

F. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.06 CLEANING

A. Leave immediate work area neat at end of each work day.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION 323113

SECTION 999999.10
APPENDIX A - GEOTECHNICAL REPORT

PART 1 GENERAL

1.01 Section Includes attachment of Geotechnical Report prepared by Geotechnical Engineer on Geotechnical Report Date. This attached document is provided for reference only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 999999.10

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SECTION 999999.20
APPENDIX B - REFRIGERATION EQUIPMENT INSTALLATION SPECIFICATIONS

PART 1 GENERAL

1.01 Section Includes refrigeration equipment installation specifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 999999.20

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SECTION 999999.30
APPENDIX C - MIXED USE AND SITE DESIGN REQUIREMENTS

(NTD: THIS APPENDIX IS NOT FOR INCLUSION IN FINAL SITE SPECIFIC PROJECT MANUAL)

PART 1 GENERAL

1.01 MIXED USE REQUIREMENTS

A. Protection from other sanitary lines in premises - all overhead drain pans for a mixed use premises shall be installed a minimum of (19'-0") nineteen feet above the finished floor. Overhead drain pans are to be installed utilizing professional workmanship and shall be installed perpendicular and parallel to the structure. The drip pans will be equipped with an alarm mechanism that will provide an alert if and in the event of a leak or other discharge from such lines. The drip pans will drain to a location approved by tenant. The maintenance, repair and replacement of the drip pans and related facilities shall be the landlord's responsibility

B. Building facades: Building facades shall include a repeating pattern of no less than 2 design elements.
   1. Canopies and awnings - use canopies and awnings along storefronts where appropriate to serve as covered walkways for pedestrians. Awnings should be compatible in size, scale, style and color with the structure on which they are located and adjacent.

C. Mechanical chases -mechanical chases are to be coordinated with the roof plan for identification of hvac and refrigeration mechanical runs. Mechanical chases are to be submitted to tenant for approval upon preparation of the final plans and specifications.

D. Exclusive use -trash enclosures, loading docks, and trash compactor areas are to be exclusive use to the tenant. Building entries and access -premises shall be oriented to and accessible from the major street frontage and directly accessible from the public sidewalk. Where possible, primary entrances shall be located at major intersections.

E. Parking: Parking and loading/unloading areas shall not create stacking/queuing issues at ingress/egress points. Site design must ensure that vehicles entering and exiting the site do not adversely impact the tenant, adjacent streets, and neighborhoods. Customer parking areas shall be located and designed to be convenient to minimize spillover to adjacent neighborhoods. Parking for residents, visitors, and/or employees shall be accommodated onsite parking and security lights shall not be obtrusive to tenant or neighboring residential properties. Parking provided to the general public shall be clearly marked and separate from private resident parking spaces.

F. Noise and Vibration: Where practical, mechanical equipment and other sources of noise shall be located away from building areas and exterior spaces designed for use by residents. Common walls between residential and non-residential uses shall be constructed to minimize the transmission of noise and vibration.

G. Bicycle Racks and / or Lockers: Commercial bicycle racks shall be in public view, close to building entrances, with high visibility and sufficient lighting.

1.02 SITE DESIGN REQUIREMENTS

A. Parking field slope -the parking field slope shall not exceed 1:50 (2% slope) in any direction unless otherwise approved by tenant.

B. Parking field identification -the parking field shall be provided with adequate signs or other approved means to identify the designated parking areas for the tenant's customers and staff. Signage and/or identification programmed installation to be approved by the tenant prior to placing order and installation.

C. City required signage -provide all city code required signage, i.e.: fire lane/no parking, tow-away, loitering, drinking, overnight parking.

D. Space size -size of parking spaces to be a minimum dimension of 9'-0" wide and a minimum of 18'-0" long or as required by local municipal ordinance.

E. Striping -striping to be (4") four inch wide, traffic yellow or white paint stripes, unless otherwise mandated by local jurisdiction or other agreement. Provide directional arrows, cross walk striping and driveway center lines striped in yellow. All fire lane striping to be painted red.

F. Speed control -provide speed control signage, pavement markings, speed humps, and other appurtenances as necessary to control vehicle speed limits. Landlord to submit site plan for tenant's approval of speed control elements as provided.

G. Aisle width -parking aisle width to be not less than (24'-0") twenty-four feet for two-way drive aisle (90) ninety degree parking, or (18'-0") eighteen feet for one-way (60) sixty degree parking; unless otherwise mandated by other agreement or as required by local municipality.

H. Main driveways -main driveways to be provided as require accessing tenant's parking field by the most feasibly direct path. Main drive along the front of the building is to be (30'-0") thirty feet wide minimum and is to be flush with the main entry walk and curb.

I. Truck access -truck access driveways to provide clear access, proper turning radius (50'-0") fifty feet interior radius, (65'-0") sixty-five feet outside radius, and maneuverability for all truck deliveries to the store based on deliveries by tractor trailer trucks approximately (75'-0") seventy-five feet in overall length (wb-67 tractor trailer designation).

J. Paving section -site paving to be engineered to provide maximum life expectancy of material conditions based on a "design period" of (20) twenty years. The landlord will submit civil and geotechnical report recommendations of paving section for tenant's approval. Unless otherwise required by site conditions and landlord's geotechnical report recommendations, the site paving sections shall be not less than the following:
   1. All truck access drives shall consist of 12" of compacted sub grade (95% compacted), 6" asphalt base, and 3" asphalt surface finish.
   2. All passenger vehicle access drives and parking areas shall consist of a minimum 12" of compacted sub grade (95% compacted), 3" asphalt base, and 2" asphalt surface finish.

3. All truck ramps shall be as indicated in prototype criteria drawings.
4. All dumpster pads shall consist of 12" compacted sub-base (95% compacted), 4" compacted granular base, and 5" 3,000 psi concrete slab with #4 steel reinforcing bar, 18" o.c. each way.
5. Loading dock -refer to prototype criteria drawings and specifications for loading dock requirements.

K. Site accessibility requirements -provide all accessibility requirements for the physically disabled in full compliance with section 4.2, local, state, and/or federal ADA statutes.

L. Slope in direction of travel -provide a finished site including fully accessible walks not to exceed a 1:50 (2%) cross slope and ramps not to exceed 1:20 (5%) slope. Curb ramps to meet current ADA requirements.

M. Slope at accessible parking -meet all requirements for accessible parking including a maximum 1:50 (2%) cross slope. Accessible parking - accessible parking spaces for the physically disabled to be provided in full compliance with current ADA requirements.

N. Accessible aisles -striping to be (4") four inch wide, traffic yellow or white paint stripes, unless otherwise mandated by local jurisdiction or other agreement and to be in full compliance with current ADA requirements. Passenger loading zones to be (60") sixty inches wide minimum

O. Site Lighting requirements - Exterior parking lot lighting shall meet or exceed the foot-candle recommendations of the Illuminating Engineering Society (IES) of North America and as represented in the most recently published edition of the IES lighting handbook, application volume. Tenant shall approve lighting levels for the area of site that pertains to Sprouts including but not limited to parking, drive aisles, building exterior, under-canopy lighting, and public walkways. All light fixtures to be per the latest prototype mentioned in this lease unless otherwise approved by Sprouts.

P. Uncovered parking field - Average foot-candle level to be no less than an average of (2) foot-candles with a (1) foot-candle minimum with a 10:1 maximum-minimum foot-candle level ratio.

Q. Covered parking field - Average foot-candle level to be no less than an average of (5) foot-candles with a (1) foot-candle minimum with a 10:1 maximum-minimum foot-candle level ratio.

R. Drive aisles - Average foot-candle level to be no less than an average of (2) foot-candles with a (1) foot-candle minimum with a 10:1 maximum-minimum foot-candle level ratio.

S. Entry(s), exit(s), and front of building walkway - Average foot-candle level to be no less than an average of (10) foot-candles.

T. Building walkways not listed above and public walkways - Average foot-candle level to be no less than an average of (3) foot-candles.

U. Front Under-canopy lighting - Average foot-candle level to be no less than an average of (20) foot-candles.

V. All lighting levels are subject to the authority having jurisdiction.

W. Provide all landscaping as indicated on the landlord's plans and approved by tenant and local authorities. Landscaping shrubs and trees immediately adjacent t pedestrian and parking areas to be of thornless varieties.

X. The combined total capacity of 150 cart storage is required. Shopping cart corrals to be provided at each collection area, which will be designed and fabricated in conformance with the tenant's plans.

Y. Provide pylon sign(s) structural support, sign cabinet and other approved assemblies (minimum of one). Signs to be separately metered and controlled by an energy management system with a photo-cell and time-clock and shall be separately metered by a common area house panel. Tenant, at its expense, shall be responsible for its own sign panel(s) on such pylon sign(s).

Z. Accessibility signs -provide all signs, pavement markings or other identification elements to meet current ADA requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 999999.30